3.3 Delta Tidal Hydraulics

Delta tidal hydraulic (hydrodynamic) conditions are the influences on the movement of water in Delta channels (e.g., tidal forces, inflows) and the effects of the movement of water in Delta channels (e.g., changes in channel flows and stages, export flows, outflow). This section describes Delta tidal hydraulic conditions and discusses potential effects of Intertie operations on Delta tidal stage, tidal and net channel flows, and tidal velocities.

3.3.1 Affected Environment

Channel tidal flows and stage variations at several Delta locations have been selected to describe possible effects of Intertie operations on Delta tidal hydraulics. Because the simulated increases in CVP Tracy pumping are relatively small, no changes are expected in the tidal hydraulic conditions at Delta locations other than channels in the south Delta. The selected locations for impact assessment are described below.

- **Old River at Clifton Court Ferry**. This station is between Grant Line Canal and the CCF intake gates. It is just downstream of the CVP Tracy Pumping Plant intake canal. The CVP and SWP pumping have the greatest combined effect on stage and flow at this station.
- **Old River at Tracy Road Bridge**. This station is a traditional stage and electrical conductivity (EC) monitoring location and is upstream of the Old River at Tracy temporary barrier and proposed permanent tidal gate structure.
- **Old River downstream of the head of Old River**. This station is located just downstream of the temporary barrier at the head of Old River and is influenced by the San Joaquin River flows and tidal stages.
- **Grant Line Canal at Tracy Road Bridge**. This station is just upstream of the temporary barrier on Grant Line Canal and about 4 miles upstream of the proposed permanent tidal gate on Grant Line Canal.
- **Middle River at Tracy Road Bridge**. This station is located just upstream of the temporary barrier near Victoria Canal and the proposed permanent tidal gate.

These south Delta locations were used to characterize the effects of Intertie operations compared with the 2001 LOD Existing Condition and 2020 LOD No Action. Under all hydraulic modeling scenarios, including the Existing Condition, No Action, and Proposed Action (both 2001 and 2020 LOD scenarios) conditions include temporary barriers operated during the irrigation season of May–October. The head of Old River barrier is also included in modeling scenarios. The head barrier is installed during the VAMP period of April 15–May 15 for protection of migrating juvenile Chinook salmon and in October and November for protection of migrating adult Chinook salmon.

3.3.2 Approach

Methodology

The major source of information for this section is simulation results from the "hydrodynamic" modules of the Delta Simulation Model (DSM2). DSM2 is a one-dimensional hydrodynamic and water quality simulation model used to predict conditions in the Delta. The model was developed by DWR and is frequently used to ascertain impacts associated with projects in the Delta, such as changes in exports, diversions, or channel geometries associated with dredging in Delta channels. Monthly flows from CALSIM are used in DSM2 for Intertie evaluations.

DSM2 was used to simulate the effects of Intertie operations on Delta channel flows as well as salt and dissolved organic carbon (DOC) transport. Appendix D, "Delta Tidal Hydrodynamic and Water Quality Modeling of the Intertie Project," and Appendix E, "DSM2 Modeling Studies of the DMC/California Aqueduct Intertie," describe the Delta hydrodynamic and water quality (i.e., salinity and DOC) modeling results.

Reclamation performed modeling of Delta hydrodynamic and water quality conditions based on CALSIM II monthly average inflows and exports for the 16-year period of water years 1976–1991. This standard 16-year simulation is routinely used for impact analysis, including the analysis presented in the CALFED Programmatic EIS/EIR (2000a). The simulations represent baseline conditions and conditions simulating implementation of the Intertie project for both the 2001 Existing Condition and 2020 No Action LODs. DSM2 calculates tidal hydraulic conditions with a 15-minute time step, which results in 96 values for each variable at each specified location for each day. For each 16-year simulation, 560,640 values are calculated for each variable at each Delta location. To report the results, each month of calculations is summarized from the "sorted" or cumulative values, as the average, 0% (minimum), 10%, 20%, 30%, 40%, 50% (median), 60%, 70%, 80%, 90%, and 100% (maximum) values. These 11 values summarize the full range of values calculated during each month of simulation. Graphics in this section (included at the end of Section 3.3) generally show the minimum, median, and maximum values for stage and for flows. Appendix D, "Delta Tidal Hydrodynamic and Water Quality Modeling of the Intertie Project," and Appendix E, "DSM2 Modeling Studies of the DMC/California Aqueduct Intertie," provide additional details on the DSM2 modeling of the Intertie operations.

The following discussion of potential hydrodynamic impacts identifies changes attributable to implementing the Proposed Action under the simulated 2001 and 2020 levels of development. This is accomplished by comparing the CALSIM II and DSM2 model results for the 2001 LOD with the Proposed Action (Proposed Action) and the 2001 LOD without the Proposed Action (Existing Condition), as well as comparing CALSIM II and DSM2 model results for the 2020 LOD with the Proposed Action (Proposed Action) and the 2020 LOD without the Proposed Action (No Action).

Significance Criteria

The hydrodynamic effects of the proposed Intertie operations were assessed based on the following criteria.

- **Export pumping effects on tidal flows, velocities, and stages.** A project alternative is considered to have a significant impact on local channel hydraulics if it would cause local flows to substantially exceed 2001 LOD Existing Condition or 2020 LOD No Action tidal flows, cause channel velocities to exceed the scouring velocity threshold of approximately 3 feet per second (feet/sec), or cause local stages to be substantially reduced below historical stages. Significant effect on stage during the irrigation season of April–October is defined to be any reductions below the assumed minimum operating level for water supply pumps and siphons of 0.0 feet msl.
- **Tidal gate effects on tidal (circulation) flows.** A project alternative is considered to have a significant impact on tidal circulation flows if it would cause monthly average tidal flows to be reduced substantially below historical tidal flows.

3.3.3 Environmental Consequences

Assessment of the Simulated Effects of Pumping on Tidal Hydraulics in the South Delta

DSM2 was used to simulate typical summer tidal stage and flow variations with a relatively low San Joaquin River inflow of 1,500 cfs and several different constant pumping cases for August 1997, with measured Martinez tides and adjusted Sacramento River daily inflows. Results for no CVP or SWP pumping were compared both to results with 4,600-cfs CVP Tracy pumping and to results with 6,680-cfs and 8,500-cfs SWP Banks pumping to identify the maximum tidal effects of the CVP and SWP pumping with no temporary barriers. These model results are considered typical of the maximum potential effects of the CVP Tracy Pumping Plant and the maximum allowed SWP Banks pumping with associated CCF gate operations. These pumping effects are included in the simulated Existing Condition and simulated No Action scenarios and do not represent direct effects of the Proposed Action.

Review of the DSM2 results indicates that the constant CVP Tracy pumping of 4,600 cfs and the tidal diversion of water into CCF for SWP Banks pumping both will cause an increase in the tidal and net flows moving from the San Joaquin River toward the pumping plants. The increased flow will move along all three pathways from the San Joaquin River:

- from the head of Old River and Grant Line Canal to the DMC,
- from the mouth of Middle River and Columbia Cut and Turner Cut to Victoria Canal and the Old River channel, and
- from the mouth of Old River through Franks Tract and down the Old River channel to the CCF gates and the DMC.

The effects of the CVP and SWP pumping on tidal stage elevations in the south Delta can be detected with the model at the head of Old River but cannot be detected at the mouth of Middle River or the mouth of Old River.

Figure 3.3-1 provides a summary of these monthly tidal stage variations for Old River at Tracy Road and Grant Line Canal at Tracy Road. From this effect of total pumping, it can be understood that the incremental effects of the 400-cfs maximum additional pumping allowed with the Proposed Action would not be measurable at these locations, even without the low stage protection provided with the temporary agricultural barriers.

Figure 3.3-2 shows the simulated effects of the full range of CVP and SWP export pumping on the tidal stage range in Old River at Clifton Court Ferry and in Middle River at Tracy Road.

Existing Condition (2001 LOD)

For tidal stage and tidal flow analysis, computer modeling was used as the basis for developing the existing tidal stage and tidal flow conditions at a 2001 Existing Condition LOD. This baseline for establishing the Existing Condition together with Proposed Action is plotted for comparative environmental analysis in the figures that follow.

No Action Alternative (2020 LOD)

For tidal stage and tidal flow analysis, computer modeling was used as the basis for developing the future tidal stage and tidal flow conditions at a 2020 LOD with No Action. The No Action Condition together with Proposed Action is plotted for comparative environmental analysis in the figures that follow.

Compared to simulated Existing Condition, under the No Action Alternative an Intertie would not be constructed or operated, and as a result no significant future change in Delta tidal hydraulic conditions would occur. Hydraulic conditions would remain largely the same. Without the Intertie, the No Action Alternative would not lead to any significant adverse environmental effect.

Proposed Action Alternative

Simulation of South Delta Tidal Hydraulics

DSM2–simulated tidal hydraulic effects from Proposed Action operations are described below for the 1976–1991 simulations period. Table 3.3-1 summarizes DSM2–simulated changes in tidal stage and tidal flow using historical August 1997 tide data and assumed San Joaquin River flows of 1,500 cfs without barriers. Table 3.3-2 gives an example period (1976–1980) of the simulated changes in the monthly range of tidal stage and flows for the impact assessment locations. Simulations included temporary barrier operations.

Impact HY-1: Effects of Intertie Pumping on Tidal Stage and Flow in Old River at Clifton Court Ferry

Modeled Existing Condition (2001 LOD) Comparison

The Old River at Clifton Court Ferry station is just downstream of the mouth of Grant Line Canal and about 1 mile north of the CVP Tracy Pumping Plant intake canal. The stages at this station are directly influenced by CVP and SWP pumping. The constant pumping at the CVP reduces the stage in Old River about 6 inches uniformly at all tidal stages. This drawdown of 6 inches provides the required change in water surface slope along Old River to supply 4,600 cfs to the CVP Tracy Pumping Plant intake. The incremental effects of the 400 cfs of pumping that the Intertie would allow would therefore be about 0.5 inch.

The maximum SWP Banks pumping with CCF gate operations would have an additional effect on the Clifton Court Ferry stage. The low tides are not lowered by as much as the higher tide stages because the diversions into CCF are generally much less during periods of low tide. The 6,680-cfs SWP pumping reduces the high-tide stages by 18–24 inches, depending on the CCF gate diversions. The low tides at Clifton Court Ferry are reduced by less than 6 inches with the maximum CVP pumping. The low-tide reductions at all other south Delta locations would be less than the 6-inch decline that was simulated at Clifton Court Ferry with the maximum CVP and SWP pumping.

As summarized in Table 3.3-1, the tidal flows at Clifton Court Ferry without CVP or SWP pumping range from approximately 8,500 cfs (downstream) to about –9,700 cfs (upstream). The maximum CVP pumping reduces the flow by about 4,000 cfs throughout the tidal cycle. All the CVP pumping flow not supplied by the head of Old River diversion that moves down Old River or Grant Line Canal must come south from Middle River or Old River and flow past the Clifton Court Ferry station. The general effect of the SWP pumping is to reduce the tidal fluctuations in the south Delta upstream of the CCF gates and thereby reduce the tidal flows moving past Clifton Court Ferry into either Grant Line Canal or Old River upstream of the DMC.

Figure 3.3-3 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Old River at Clifton Court Ferry (just upstream of the

CCF intake) for the simulated Existing Condition. When overlaid with the Proposed Action effect on stage and flow, Figure 3.3-3 graphically represents how small a change in minimum, median, and maximum tidal stage and tidal flow actually occurs as a result of Proposed Action operations. The minimum stage of 0 feet msl does not apply at this location, which is downstream of the temporary barrier protection zone. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Modeled No Action Condition (2020 LOD) Comparison

Figure 3.3-4 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Old River at Clifton Court Ferry (just upstream of the CCF intake) for the simulated No Action scenario. Processes affecting tidal stage and flow related to Proposed Action operations would be similar to that explained above for the Existing Condition comparison. Figure 3.3-4 shows relatively small changes in tidal stage and tidal flow when comparing Proposed Action operations against the simulated No Action scenario. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Impact HY-2: Effects of Intertie Pumping on Tidal Stage and Flow in Old River at Tracy Road Bridge

Modeled Existing Condition (2001 LOD) Comparison

The Old River at Tracy Road Bridge is located about 9 miles upstream of the CVP Tracy intake to the Tracy Pumping Plant and about 2 miles downstream of the Doughty Cut, which connects to the Grant Line Canal. The tidal stage variation at this location without CVP or SWP pumping is almost the same as the tidal stage variation at Old River at Bacon Island. The high tide is about 4.0 feet msl, and the low tide is about 0.0 feet msl. The low tide at Tracy Road Bridge is apparently influenced by the higher-tide elevation at the head of Old River, which is maintained by the San Joaquin River flows at Mossdale. The effect of the maximum CVP pumping of 4,600 cfs is to reduce the stage at Tracy Road Bridge by about 6 inches throughout the tidal range. The rising tides are reduced a little more than the falling tides because the rising tide flow moves past the Tracy DMC intake and is diverted, whereas the falling tide flow moves from upstream past the Tracy Road Bridge and is less affected by the Tracy pumping.

The SWP pumping of 6,680 cfs reduces the Tracy Road Bridge stage by an additional 3–6 inches at the low tide (i.e. lowest tide during the month), reducing the low tide to about –1.0 foot msl. The SWP pumping has a larger effect on the high tides at Tracy Road because more of the flood-tide flows moving upstream in Old River are diverted into CCF, so the Old River and Grant Line Canal channels do not fill as high as with no pumping. The high tides at Tracy Road are reduced by 18–24 inches from the no pumping conditions. The highest tides are reduced from approximately 4.0 feet msl to just over 2.5 feet msl. This reduction may have an effect on the water level that can be maintained in Tom Paine Slough, which is connected to Old River with siphons and tidal gates.

Table 3.3-1. DSM2-Simulated Change in Tidal Stage and Tidal Flow for South Delta Channel Locations with Increasing CVP and SWP Pumping, Using August 1997 Historical Tides and San Joaquin River Flow of 1,500 Cubic Feet per Second with No Barriers

Pumping	Stage (feet above mean sea level)					Flow (cubic feet per second)				
Central Valley Project	0	4,600	4,600	4,600	4,600	0	4,600	4,600	4,600	4,600
State Water Project	0	0	6,680	8,500	10,300	0	0	6,680	8,500	10,300
Total	0	4,600	11,280	13,100	14,900	0	4,600	11,280	13,100	14,900
Head of Old River										
Average	2.175	1.961	1.63	1.556	1.474	895	1,078	1,342	1,393	1,452
0	0.88	0.7	0.47	0.39	0.32	-832	-407	738	854	957
10	1.32	1.15	0.89	0.82	0.75	35	383	891	951	996
20	1.52	1.36	1.09	1.02	0.94	570	742	933	967	1,013
30	1.73	1.54	1.26	1.2	1.12	814	906	958	984	1,031
40	1.92	1.73	1.43	1.36	1.28	899	980	993	1,021	1,063
50	2.12	1.92	1.6	1.53	1.44	952	1,025	1,137	1,208	1,309
60	2.32	2.1	1.76	1.69	1.61	998	1,162	1,594	1,633	1,689
70	2.52	2.29	1.94	1.86	1.78	1,148	1,442	1,750	1,795	1,844
80	2.8	2.56	2.16	2.08	1.99	1,376	1,587	1,837	1,896	1,955
90	3.13	2.87	2.43	2.35	2.26	1,561	1,669	1,910	1,978	2,052
100	4.05	3.76	3.26	3.17	3.08	1,845	1,859	2,052	2,136	2,223
Old River at Clifton Court Ferry										
Average	1.577	1.206	0.587	0.397	0.166	497	-3,900	-3,600	-3,542	-3,471
0	-0.47	-0.88	-0.98	-1.15	-1.36	-9,785	-13,497	-10,526	-10,333	-10,108
10	0.19	-0.18	-0.42	-0.61	-0.84	-7,823	-11,498	-8,948	-8,719	-8,459
20	0.59	0.22	-0.11	-0.3	-0.52	-6,813	-10,521	-8,165	-7,921	-7,650
30	0.9	0.53	0.1	-0.08	-0.3	-5,488	-9,303	-7,251	-6,933	-6,613
40	1.22	0.84	0.31	0.13	-0.09	-2,800	-7,128	-5,677	-5,391	-5,161
50	1.55	1.17	0.54	0.35	0.12	2,179	-3,920	-3,765	-3,677	-3,462
60	1.88	1.5	0.77	0.58	0.34	5,369	10	-1,573	-1,710	-1,772

Pumping	Stage (feet above mean sea level)					Flow (cubic feet per second)				
Central Valley Project	0	4,600	4,600	4,600	4,600	0	4,600	4,600	4,600	4,600
State Water Project	0	0	6,680	8,500	10,300	0	0	6,680	8,500	10,300
Total	0	4,600	11,280	13,100	14,900	0	4,600	11,280	13,100	14,900
70	2.19	1.83	1	0.81	0.56	6,405	1,913	95	-94	-353
80	2.54	2.17	1.3	1.11	0.87	6,936	2,631	1,096	941	734
90	3.01	2.65	1.66	1.45	1.2	7,402	3,221	1,792	1,721	1,580
100	4.03	3.66	2.66	2.45	2.21	8,533	4,542	3,140	2,985	2,838
Old River at Tracy Road Bridge										
Average	1.636	1.238	0.616	0.427	0.196	102	164	176	173	168
0	-0.18	-0.54	-0.79	-0.95	-1.15	-764	-575	-327	-319	-316
10	0.38	0	-0.33	-0.5	-0.71	-536	-373	-210	-207	-208
20	0.7	0.33	-0.06	-0.24	-0.45	-482	-328	-177	-172	-169
30	0.97	0.58	0.12	-0.04	-0.26	-432	-287	-147	-142	-137
40	1.25	0.86	0.33	0.16	-0.06	-178	-134	-32	-28	-14
50	1.56	1.16	0.55	0.36	0.13	395	353	252	249	237
60	1.89	1.48	0.78	0.58	0.33	503	511	413	400	381
70	2.21	1.8	1	0.8	0.55	543	558	467	454	440
80	2.55	2.12	1.29	1.09	0.84	581	600	507	496	482
90	3.02	2.59	1.65	1.44	1.18	617	640	539	530	515
100	4.12	3.72	2.72	2.51	2.26	728	748	643	631	618
Grant Line Canal at Tracy Road										
Average	1.691	1.324	0.718	0.54	0.322	552	692	980	1,042	1,118
Minimum	-0.13	-0.46	-0.67	-0.81	-1	-4,031	-3,548	-1,903	-1,756	-1,590
10	0.45	0.1	-0.22	-0.4	-0.6	-3,067	-2,569	-1,189	-1,051	-885
20	0.77	0.42	0.04	-0.12	-0.33	-2,678	-2,166	-897	-753	-565
30	1.05	0.7	0.23	0.06	-0.14	-2,193	-1,723	-571	-391	-190

Pumping	Stage (feet above mean sea level)					Flow (cubic feet per second)				
Central Valley Project	0	4,600	4,600	4,600	4,600	0	4,600	4,600	4,600	4,600
State Water Project	0	0	6,680	8,500	10,300	0	0	6,680	8,500	10,300
Total	0	4,600	11,280	13,100	14,900	0	4,600	11,280	13,100	14,900
40	1.34	0.97	0.45	0.28	0.06	-800	-759	176	340	549
50	1.64	1.26	0.66	0.48	0.26	1,832	1,327	1,214	1,272	1,383
60	1.95	1.58	0.88	0.7	0.47	2,768	2,665	2,061	2,018	2,002
70	2.25	1.88	1.11	0.91	0.69	3,033	3,085	2,476	2,415	2,359
80	2.58	2.2	1.4	1.21	0.98	3,213	3,309	2,763	2,717	2,662
90	3.02	2.64	1.75	1.54	1.31	3,349	3,493	2,967	2,945	2,895
Max	4.07	3.7	2.75	2.55	2.32	3,704	3,909	3,458	3,425	3,384
Middle River at Tracy Road Bridge										
Average	1.559	1.313	0.98	0.885	0.786	-17	-36	-72	-79	-87
0	-0.47	-0.76	-0.87	-1	-1.09	-1,347	-1,306	-1,111	-1,100	-1,088
10	0.2	-0.06	-0.25	-0.37	-0.47	-1,002	-961	-811	-797	-787
20	0.58	0.33	0.1	0	-0.07	-848	-812	-688	-677	-667
30	0.9	0.65	0.38	0.28	0.19	-698	-672	-573	-564	-552
40	1.21	0.96	0.64	0.56	0.47	-446	-463	-433	-423	-410
50	1.54	1.28	0.94	0.85	0.75	230	44	-128	-144	-149
60	1.85	1.61	1.23	1.15	1.05	544	492	306	271	236
70	2.16	1.93	1.52	1.44	1.33	648	618	474	456	421
80	2.5	2.26	1.84	1.75	1.65	735	710	570	555	531
90	2.97	2.73	2.26	2.17	2.08	822	801	668	648	614
100	4.11	3.9	3.36	3.26	3.16	1,024	1,038	883	838	793

Pumping	Stage (feet above mean sea level)					Flow (cubic feet per second)				
Central Valley Project	0	4,600	4,600	4,600	4,600	0	4,600	4,600	4,600	4,600
State Water Project	0	0	6,680	8,500	10,300	0	0	6,680	8,500	10,300
Total	0	4,600	11,280	13,100	14,900	0	4,600	11,280	13,100	14,900
Middle River at Mowery Bridge										
Average	1.882	1.567	1.019	0.874	0.699	90	71	34	28	20
0	0.21	-0.05	-0.3	-0.41	-0.54	-18	-48	-106	-114	-125
10	0.74	0.46	0.13	0	-0.14	31	17	-18	-27	-39
20	1.03	0.74	0.36	0.23	0.07	38	24	17	13	8
30	1.29	1	0.56	0.43	0.26	45	30	22	17	12
40	1.56	1.25	0.76	0.62	0.45	55	38	26	21	15
50	1.84	1.53	0.97	0.82	0.64	65	49	31	25	19
60	2.12	1.79	1.17	1.02	0.84	83	70	39	33	26
70	2.39	2.06	1.39	1.22	1.05	123	104	52	46	38
80	2.7	2.36	1.66	1.51	1.32	159	135	72	63	52
90	3.1	2.77	1.99	1.83	1.63	184	156	87	78	68
100	4.13	3.8	2.98	2.81	2.62	218	190	112	106	97

Table 3.3-2. DSM2 Simulated Changes in Tidal Stage and Tidal Flows at Selected South Delta Channel Locations for 1976–1980

	Old River at Clifton Court Ferry						Old River at Tracy Road Bridge						Downstream of Head of Old River						Grant Line Canal at Tracy Road Bridge						Middle River at Tracy Road Bridge					
	Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)		
Date	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%
Oct-75	-0.01	-0.04	-0.04	-244	-258	-302	0.00	-0.01	-0.02	45	-1	-16	-0.01	-0.01	-0.01	0	1	1	0.00	-0.01	-0.01	5	2	0	0.00	0.00	-0.01	10	0	-7
Nov-75	-0.03	-0.07	-0.04	-280	-348	-371	-0.03	-0.01	-0.02	66	0	-14	-0.02	-0.01	-0.02	1	2	4	-0.04	-0.01	-0.02	7	3	-2	-0.02	0.00	-0.02	21	0	-7
Dec-75	-0.04	-0.04	-0.05	-339	-365	-382	-0.04	-0.03	-0.04	55	8	-19	-0.01	-0.02	-0.02	8	11	13	-0.05	-0.02	-0.02	10	4	-2	-0.03	-0.02	-0.03	0	-2	-3
Jan-76	-0.02	0.01	-0.03	-193	-372	-403	0.00	0.01	-0.03	67	-3	-8	0.00	0.00	-0.01	3	2	-5	-0.02	0.00	-0.01	13	6	-5	-0.01	0.01	0.00	-2	0	-12
Feb-76	0.02	0.03	0.02	156	153	168	0.02	0.03	0.02	-23	-7	3	0.00	0.01	0.01	-10	-7	-9	0.01	0.01	0.01	-9	-1	1	0.01	0.01	0.01	3	1	5
Mar-76	0.03	0.03	0.04	201	301	311	0.03	0.04	0.04	-23	-8	-4	0.02	0.01	0.02	-11	-9	-12	0.02	0.01	0.02	-9	-2	1	0.02	0.02	0.01	-4	1	1
Apr-76	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
May-76	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jun-76	0.00	-0.01	0.00	-1	0	-1	0.00	0.00	0.00	1	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jul-76	-0.02	-0.02	-0.01	16	-3	-14	-0.01	-0.01	-0.01	8	-4	-11	-0.01	-0.02	-0.02	-5	-4	-6	-0.01	-0.02	-0.02	-1	1	-1	-0.01	0.00	-0.02	7	0	-8
Aug-76	0.00	-0.01	0.00	2	0	0	0.00	0.00	-0.01	1	0	-1	0.00	0.00	0.00	0	0	-1	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	1	0	-1
Sep-76	-0.01	-0.01	0.00	0	-1	-10	-0.01	-0.01	-0.01	4	-2	-3	-0.01	0.00	-0.01	-1	-2	-4	-0.01	0.00	-0.01	1	0	1	0.00	0.00	0.00	1	0	-4
Oct-76	-0.01	-0.01	-0.02	-121	-168	-155	0.00	0.00	-0.01	33	0	-12	0.00	0.00	-0.01	1	1	2	0.00	0.00	-0.01	2	1	2	0.00	0.00	0.00	5	0	-2
Nov-76	-0.01	0.00	0.00	-57	-64	-62	0.00	0.00	-0.01	6	1	-2	0.00	0.00	0.00	1	1	2	-0.01	0.00	0.00	1	1	0	-0.01	-0.01	0.00	1	0	-1
Dec-76	0.02	0.04	0.05	-330	-19	102	0.02	0.05	0.06	-127	-18	8	0.02	0.03	0.04	-39	-16	-8	0.01	0.03	0.04	-17	-1	6	0.01	0.04	0.03	-28	3	7
Jan-77	-0.01	-0.03	-0.02	-64	-83	-127	-0.01	-0.02	-0.02	13	7	-2	-0.01	-0.01	0.00	20	8	10	-0.01	-0.01	0.00	8	1	1	0.00	-0.01	-0.01	5	-1	-2
Feb-77	0.00	0.00	0.00	13	3	-2	0.00	0.00	0.00	4	2	-1	0.00	0.01	0.00	5	3	2	0.00	0.01	0.00	0	0	0	-0.01	0.00	0.00	0	0	0
Mar-77	0.00	0.00	-0.03	47	6	-25	0.00	0.00	-0.02	24	5	-10	0.00	-0.01	-0.01	19	5	-1	-0.01	-0.01	-0.01	1	1	-2	-0.01	-0.01	0.00	2	0	-3
Apr-77	0.00	0.00	0.00	-5	0	1	0.00	0.00	0.00	-2	0	0	0.01	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	-1	0	2
May-77	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jun-77	0.00	0.00	0.00	1	0	-1	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	-0.01	0.00	0.00	0	0	0
Jul-77	0.00	0.01	0.01	0	1	5	0.01	0.00	0.00	-5	2	6	0.01	0.00	0.00	0	1	2	0.00	0.00	0.00	-1	0	0	0.01	0.00	0.01	-4	0	3
Aug-77	0.00	0.00	0.00	0	0	1	0.00	0.00	0.00	-1	0	1	0.01	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	-1	0	1
Sep-77	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Oct-77	0.00	0.00	-0.01	43	1	2	0.00	0.00	0.00	13	0	-8	0.00	-0.01	-0.01	-2	0	-1	-0.01	-0.01	-0.01	1	0	0	0.00	0.00	-0.01	2	0	-2
Nov-77	0.01	0.01	0.02	78	91	105	0.01	0.00	0.01	-18	-1	10	0.00	0.01	0.01	-1	-2	-3	0.01	0.01	0.01	-4	-2	1	0.00	0.01	0.01	-5	1	4
Dec-77	-0.01	-0.02	-0.03	-116	-159	-166	-0.01	-0.03	-0.02	19	6	-6	-0.01	-0.01	-0.02	10	8	9	-0.02	-0.01	-0.02	4	2	-1	-0.01	-0.02	-0.01	3	-1	3
Jan-78	-0.04	-0.02	-0.04	-231	-379	-388	-0.02	-0.03	-0.03	37	3	-13	-0.01	-0.01	-0.02	6	8	13	-0.02	-0.01	-0.02	25	6	-2	-0.02	-0.02	-0.02	1	-2	-3
Feb-78	-0.03	-0.04	-0.04	-309	-373	-423	-0.03	-0.04	-0.04	-3	4	-14	0.00	-0.01	-0.02	7	5	4	-0.04	-0.01	-0.02	20	3	-3	-0.03	-0.02	-0.03	-2	-2	-2
Mar-78	0.07	0.09	0.10	707	879	990	0.05	0.07	0.10	-158	-11	21	0.02	0.02	0.01	-20	-9	-6	0.07	0.02	0.01	-29	-3	8	0.06	0.04	0.05	1	4	5
Apr-78	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0

	Old River at Clifton Court Ferry						Old River at Tracy Road Bridge						Downstream of Head of Old River						Grant Line Canal at Tracy Road Bridge						Middle River at Tracy Road Bridge					
	Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)			Stage (msl)			Flow (cfs)		
Date	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%	Min	50%	Max	10%	Average	90%
May-78	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jun-78	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jul-78	0.00	-0.01	-0.01	3	-1	-3	0.00	-0.01	0.00	2	-1	-3	-0.01	0.00	-0.01	-1	-1	-3	0.00	0.00	-0.01	0	0	0	-0.01	0.00	-0.01	3	0	-3
Aug-78	0.01	0.00	0.00	0	0	1	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Sep-78	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Oct-78	-0.02	-0.05	-0.03	-245	-247	-290	-0.01	-0.01	-0.02	27	0	-14	0.00	-0.01	-0.02	1	1	2	0.00	-0.01	-0.02	4	2	1	0.00	-0.01	-0.02	11	-1	-8
Nov-78	0.00	0.02	0.01	-108	-121	-78	0.00	0.01	-0.01	-1	-1	-1	0.00	0.00	-0.01	0	0	-1	-0.02	0.00	-0.01	0	1	1	0.00	0.00	0.00	3	0	-3
Dec-79	0.00	-0.01	-0.03	55	-7	-17	-0.01	-0.01	0.00	14	2	-4	0.00	0.00	-0.01	2	2	0	0.00	0.00	-0.01	0	0	0	0.00	0.00	0.00	3	0	-1
Jan-79	0.03	0.03	0.02	141	203	228	0.02	0.03	0.03	-30	-2	11	0.00	0.01	0.01	-3	-3	-4	0.01	0.01	0.01	-10	-2	3	0.02	0.02	0.02	-3	1	3
Feb-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Mar-79	0.00	0.00	0.00	-2	-3	-3	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Apr-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
May-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jun-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jul-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Aug-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Sep-79	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Oct-79	-0.02	0.00	-0.02	-267	-244	-233	0.00	-0.01	-0.01	29	0	-10	-0.01	0.00	-0.01	0	1	0	0.00	0.00	-0.01	3	2	2	0.00	0.00	0.00	6	-1	-3
Nov-79	0.00	0.01	0.00	-16	-26	9	0.00	0.00	0.00	-2	0	-1	0.00	0.00	0.01	0	0	-1	0.00	0.00	0.01	0	0	0	0.00	0.00	0.01	0	0	0
Dec-79	-0.03	-0.06	-0.05	-246	-358	-415	-0.03	-0.06	-0.06	22	14	-12	-0.01	-0.02	-0.03	16	16	23	-0.03	-0.02	-0.03	7	5	1	-0.02	-0.04	-0.04	8	-3	-4
Jan-80	-0.04	-0.04	-0.03	-282	-367	-373	-0.02	-0.02	-0.03	20	3	-18	0.00	0.00	0.00	6	3	2	-0.02	0.00	0.00	17	2	-3	-0.03	-0.01	-0.02	5	-2	-4
Feb-80	-0.03	-0.02	-0.03	-301	-354	-364	-0.02	-0.02	-0.02	21	3	4	0.00	0.00	0.00	3	2	1	-0.02	0.00	0.00	3	-1	-2	-0.02	-0.02	-0.01	2	-1	2
Mar-80	0.14	0.13	0.12	982	1177	1199	0.07	0.11	0.12	-62	-16	7	0.01	0.02	0.01	-11	-11	-9	0.10	0.02	0.01	-35	-1	13	0.09	0.08	0.05	-6	6	9
Apr-80	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
May-80	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jun-80	0.00	0.00	0.00	-1	0	1	0.00	0.00	0.01	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Jul-80	-0.02	-0.02	-0.02	27	-4	-12	0.00	-0.01	-0.02	9	-3	-13	0.00	-0.01	-0.01	-2	-5	-8	-0.01	-0.01	-0.01	0	-1	-4	-0.01	-0.01	-0.02	10	0	-7
Aug-80	0.00	0.00	0.00	-1	0	1	0.00	-0.01	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0
Sep-80	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00	0	0	0

msl = above mean sea level.

cfs = cubic feet per second.

As summarized in Table 3.3-1, without any CVP or SWP pumping, the tidal flows range from approximately 700 cfs during ebb tide (downstream) to approximately –800 cfs during flood tide (upstream). With maximum CVP pumping, the ebb-tide flows are not changed significantly, but the flood-tide flows are reduced by about 200 cfs. With additional SWP pumping of 6,680 cfs, the tidal flows range from approximately 600 cfs during the ebb tide to approximately –300 cfs during the flood tide.

Table 3.3-1 indicates that the average net flow in Old River is 102 cfs with no pumping and increases to 164 cfs with 4,600 cfs of CVP pumping. This result indicates that most of the flow from head of Old River moves down Grant Line Canal to the CVP intake. SWP pumping of 6,680 cfs does not increase the net flow at Tracy Road Bridge by more than 15 cfs. The SWP pumping increases the head of Old River flow by only about 300 cfs, with most of this water moving down Grant Line Canal to the CCF gates. The CVP and SWP pumping would lower the tidal stage in Old River at Tracy Road Bridge and reduce the flood-tide flows but would have only a slight effect on the net flow in Old River between Doughty Cut and the DMC.

Figure 3.3-5 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Old River at Tracy Road Bridge, located upstream of the temporary barrier and proposed tidal gates for the simulated Existing Condition. When overlaid with the Proposed Action effect on tidal stage and tidal flow, Figure 3.3-5 graphically represents how small a change in minimum, median, and maximum tidal stage and tidal flow actually occurs as a result of Proposed Action operations. The minimum stage is protected above the 0.0 feet msl target in the irrigation season, when the temporary barriers hold the minimum stage at about 1.0 foot msl. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Modeled No Action Condition (2020 LOD) Comparison

Figure 3.3-6 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Old River at the Tracy Road Bridge for the 2020 No Action scenario. Processes affecting tidal stage and flow related to Proposed Action operations would be similar to that explained above for the Existing Condition comparison. Figure 3.3-6 shows relatively small changes in tidal stage and tidal flow when comparing Proposed Action operations to the simulated No Action scenario. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Impact HY-3: Effects of Intertie Pumping on Tidal Stage and Flow in Old River at the Head of Old River.

Modeled Existing Condition (2001 LOD) Comparison

The head of Old River is located about 24 miles upstream of the CVP Tracy DMC intake along the Old River channel. Without any CVP or SWP pumping, tidal variations at the head of Old River range from a high tide of about 4.0 feet msl during the spring tide period in the middle of the month to a low tide of about 1.0 foot msl when the San Joaquin River flow is 1,500 cfs. The effects of the 4,600-cfs constant pumping at the CVP Tracy Pumping Plant are to reduce the stage by about 2 inches at low tide and about 4 inches at high tide. The incremental effects of just the 400 cfs of additional pumping allowed with the Intertie action would not be measurable.

The simulated influence of maximum CVP and SWP pumping is a slight reduction in the stage at the head of Old River. This influence increases the diversion of flow from the San Joaquin River at Mossdale into the Old River channel and produces a higher net flow into the head of Old River. The San Joaquin River stage at Mossdale cannot be lowered sufficiently by CVP or SWP pumping to produce a net upstream flow from Stockton, unless the total pumping is more than 10 times the San Joaquin River flow at Vernalis. Higher pumping would cause a greater fraction of the San Joaquin River flow to be diverted into Old River.

Table 3.3-1 indicates that with a San Joaquin River flow of 1,500 cfs, the head of Old River diversion is approximately 895 cfs with no CVP or SWP pumping (with simulated south Delta agricultural diversions of about 1,000 cfs and CCWD diversions of 207 cfs). The simulations illustrate the head of Old River monthly average diversion increased to 1,078 cfs with CVP pumping of 4,600 cfs and increased to 1,342 cfs with the maximum SWP pumping of 6,680 cfs. This result suggests that the diversion was initially about 60% of the San Joaquin River flow and increased by about 4% of the export pumping.

Figure 3.3-7 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Old River at the head of Old River, just downstream of the temporary barrier and proposed tidal gate for the simulated Existing Condition. When overlaid with the Proposed Action effect on tidal stage and tidal flow, Figure 3.3-7 graphically represents how small a change in minimum, median, and maximum tidal stage and tidal flow actually occurs as a result of Proposed Action operations. The changes in the tidal stage and flows are very small because the same San Joaquin River flows and barrier installation were simulated under the Proposed Action. The temporary barriers held the minimum stage at 1.0 foot msl during the summer irrigation months. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Modeled No Action Condition (2020 LOD) Comparison

Figure 3.3-8 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Old River at the Head of Old River for the simulated No Action scenario. Processes affecting tidal stage and flow related to Proposed Action operations would be similar to those explained above for the Existing Condition comparison. Figure 3.3-8 shows relatively small changes in tidal stage and tidal flow comparing Proposed Action operations against the simulated No Action scenario. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Impact HY-4: Effects of Intertie Pumping on Tidal Stage and Flow in Grant Line Canal at Tracy Road Bridge.

Modeled Existing Condition (2001 LOD) Comparison

The Grant Line Canal at Tracy Road Bridge station is located near the upstream end of Grant Line Canal, about 5.5 miles upstream of the Grant Line Canal mouth near the CVP intake to the Tracy Pumping Plant and the CCF intake gates. The Grant Line temporary barrier is installed each year at this location. The tidal stage variation at this location without CVP or SWP pumping is almost the same as the tidal stage variation at Old River at Bacon Island. The high tide is about 4.0 feet msl, and the low tide is about –0.25 foot msl. The low tide in Grant Line Canal at the Tracy Road Bridge is apparently influenced by the higher tide elevation at the head of Old River that is maintained by the San Joaquin River flows at Mossdale. The effect of the maximum CVP pumping of 4,600 cfs is a reduction in the stage in Grant Line Canal by about 6 inches throughout the tidal range.

The SWP pumping reduces the Tracy Road Bridge stage by an additional 3–6 inches at low tide, reducing the low tide to about –1.0 foot msl. The SWP pumping has a larger effect on the high tides in Grant Line Canal because more of the flood-tide flows moving upstream in Old River are diverted into CCF, so the Old River and Grant Line Canal channels do not fill as high as with no pumping. The higher tides in Grant Line Canal are reduced by 18–24 inches from the no pumping conditions.

As summarized in Table 3.3-1, without CVP or SWP pumping, the tidal flows ranged from approximately 3,700 cfs during ebb tide (downstream) to approximately –4,000 cfs during flood tide (upstream). With maximum CVP pumping, the ebb-tide flows increased by about 200 cfs, but the flood-tide flows were reduced by about 500 cfs. With additional SWP pumping of 6,680 cfs, the tidal flows in Grant Line Canal ranged from approximately 3,400 cfs during the ebb tide to approximately –1,900 cfs during the flood tide.

Table 3.3-1 indicates that the net flow in Grant Line Canal is 552 cfs with no pumping and increases to 692 cfs with 4,600 cfs of CVP pumping. This result indicates that most of the head of Old River flow from the San Joaquin River moves down Grant Line Canal to the CVP intake. SWP pumping of 6,680 cfs increases the net flow in Grant Line Canal at Tracy Road Bridge to 980 cfs. The SWP pumping increases the head of Old River flow by only about 300 cfs, and almost all of this water moved down Grant Line Canal to the CCF gates. The CVP and SWP pumping would lower the tidal stage in Grant Line Canal at Tracy Road Bridge, would reduce the tidal flows somewhat, and would increase the net flow in Grant Line Canal as the head of Old River diversion from the San Joaquin River is increased.

Figure 3.3-9 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Grant Line Canal at Tracy Road Bridge, just upstream of the temporary barriers for the simulated Existing Condition. When overlaid with the Proposed Action effect on tidal stage and tidal flow, Figure 3.3-9 graphically represents how small a change in minimum, median, and maximum tidal stage and tidal flow actually occurs as a result of Proposed Action operations. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Modeled No Action Condition (2020 LOD) Comparison

Figure 3.3-10 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Grant Line Canal at the Tracy Road Bridge for the simulated No Action scenario. Processes affecting tidal stage and flow related to Proposed Action operations would be similar to those explained above for the Existing Condition comparison. Figure 3.3-10 shows relatively small changes in tidal stage and tidal flow comparing Proposed Action operations against the simulated No Action scenario. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

Impact HY-5: Effects of Intertie Pumping on Tidal Stage and Flow in Middle River at Tracy Road Bridge.

Modeled Existing Condition (2001 LOD) Comparison

The Middle River at Tracy Road Bridge station is located about 1.75 miles upstream of the junction with Victoria Canal. The Middle River temporary barrier weir is installed downstream of this location near the junction with Victoria Canal each year. The tidal stage variation without any CVP or SWP pumping ranges from a high tide of about 4.0 feet msl to a low tide of about –0.5 foot msl. This range is very similar to the tidal range for the Middle River at Bacon Island station. The effects of the maximum CVP pumping of 4,600 cfs are very small, with a reduction of about 3 inches throughout the tidal range. The maximum SWP pumping of 6,680 cfs evenly reduces the stage over the tidal range by about 6 inches from no pumping conditions.

As summarized in Table 3.3-1, without CVP or SWP pumping, the tidal flows into Middle River from Old River are relatively small, with peak flows during flood tides of approximately –1,350 cfs and approximately 1,000 cfs at ebb tide. Table 3.3-1 indicates that the net flow in Middle River at the Tracy Road Bridge is approximately –17 cfs with no pumping and approximately –36 cfs with CVP pumping of 4,600 cfs. SWP pumping of 6,680 cfs further reduces the Middle River net flow to –72 cfs.

Figure 3.3-11 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Middle River at Tracy Road Bridge, just upstream of the temporary barrier for the simulated Existing Condition. When overlaid with the Proposed Action effect on tidal stage and tidal flow, Figure 3.3-11 graphically represents how small a change in minimum, median, and maximum tidal stage and tidal flow actually occurs as a result of Proposed Action operations. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

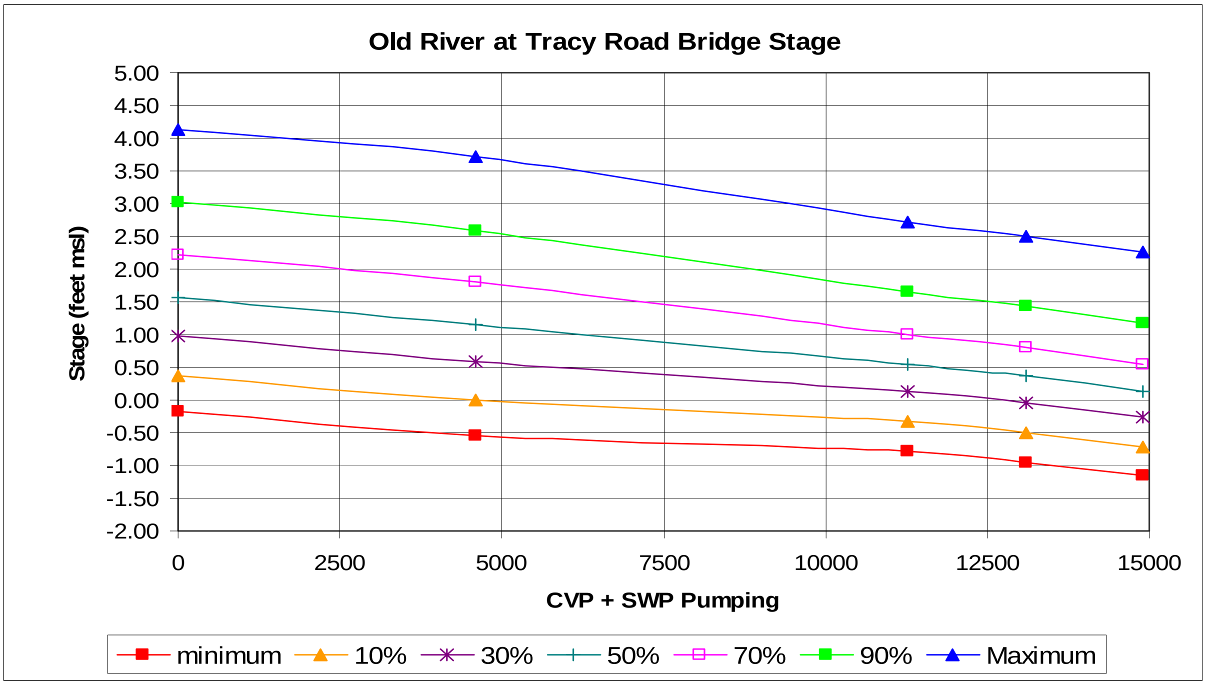
Modeled No Action Condition (2020 LOD) Comparison

Figure 3.3-12 shows the 16-year period of minimum, median, and maximum tidal stage and tidal flows in Middle River at the Tracy Road Bridge for the simulated No Action scenario. Processes affecting tidal stage and flow related to Proposed Action operations would be similar to those explained above for the Existing Condition comparison. Figure 3.3-12 shows relatively small changes in tidal stage and tidal flow when comparing Proposed Action operations against the simulated No Action scenario. Impacts on tidal stage and tidal flow are considered less than significant. No mitigation is required.

3.3.4 Cumulative Impacts

Proposed Action pumping will not have any greater effects on south Delta tidal hydraulics than were simulated for the Existing Condition and No Action. As stated previously, the DSM2 simulations represent both baseline conditions (2001 simulated Existing Condition and 2020 No Action) and conditions with implementation of the Proposed Action. Although future additional pumping at the SWP Banks Pumping Plant is possible, the effects of this additional export pumping on tidal conditions in the south Delta are not increased by the Proposed Action. There are no cumulative effects of the Proposed Action on south Delta tidal hydraulics.

Figure 3.3-1. Summary of DSM2–Simulated Effects of Export Pumping on the Tidal Stage Ranges in Old River at Tracy Road and in Grant Line Canal at Tracy Road for August 1997 Tides and San Joaquin River Flow of 1,500 cfs



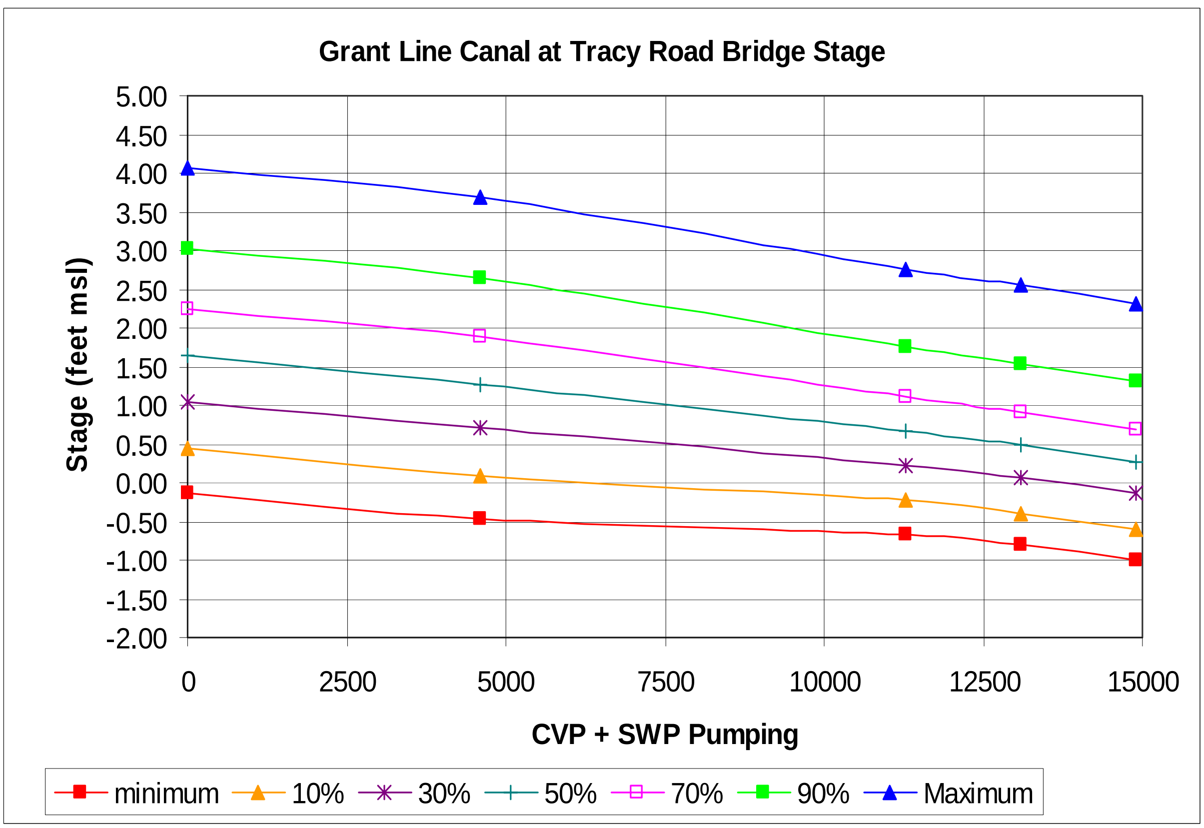
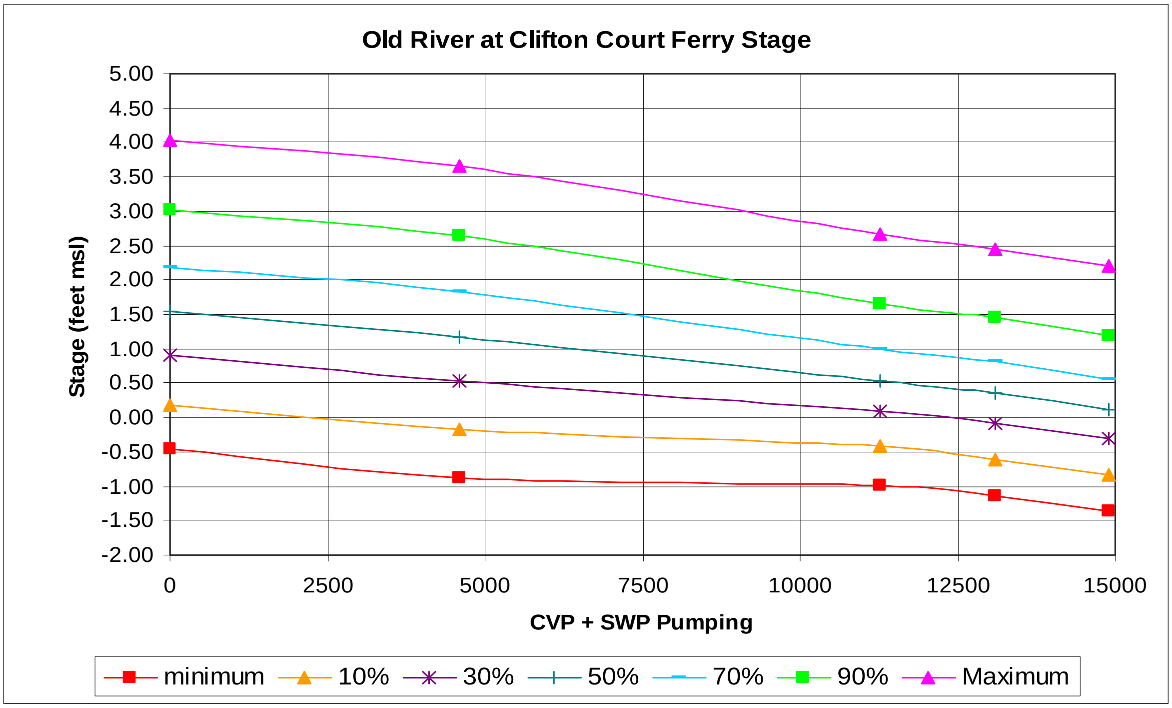


Figure 3.3-2. Summary of DSM2–Simulated Effects of Export Pumping on the Tidal Stage Ranges in Old River at Clifton Court Ferry and in Middle River at Tracy Road for August 1997 Tides and San Joaquin River Flow of 1,500 cfs



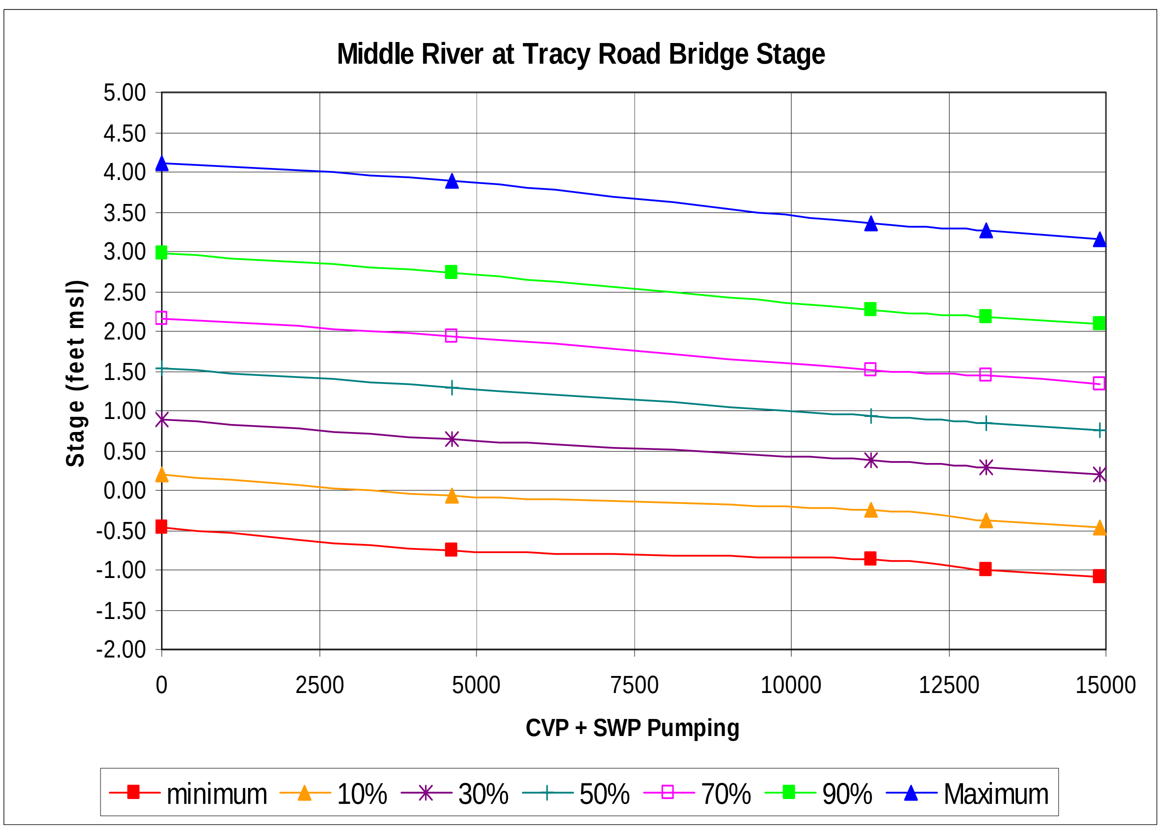
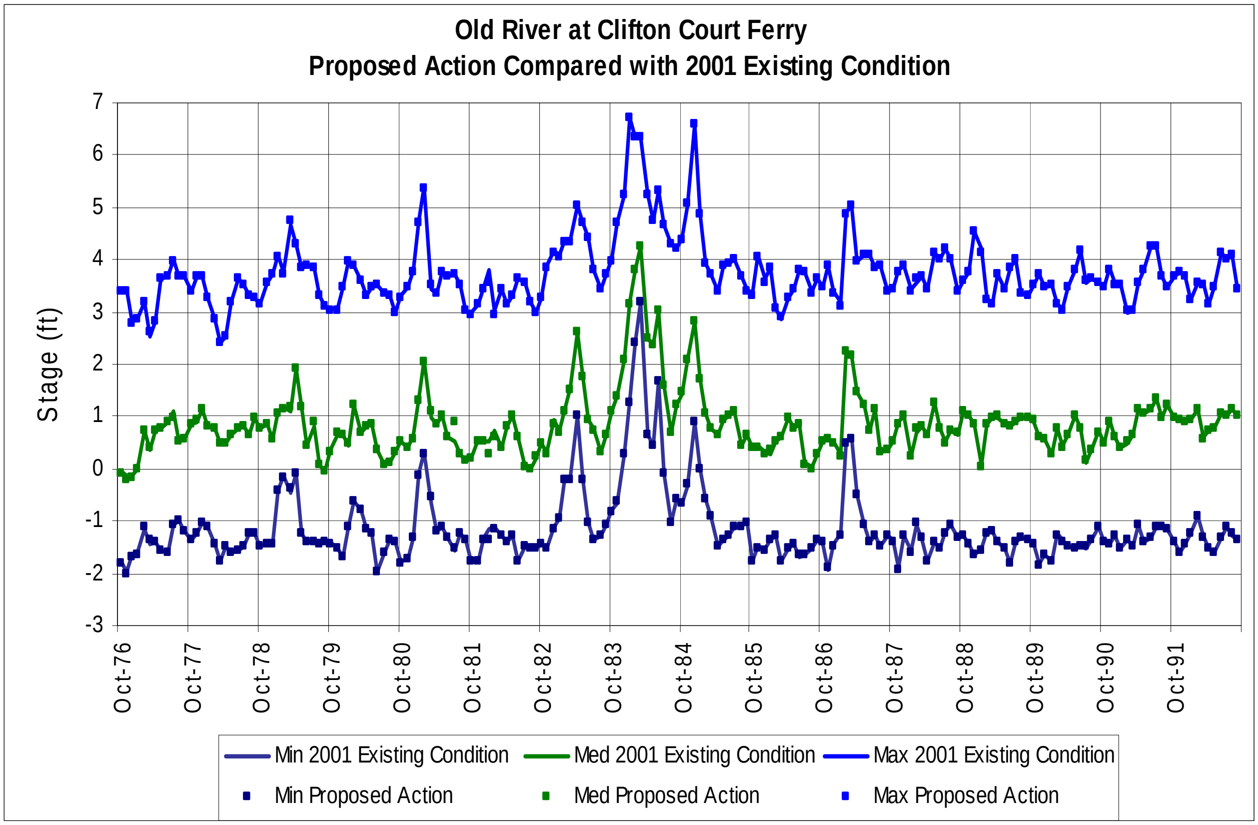


Figure 3.3-3. DSM2–Simulated Tidal Stage and Tidal Flow in Old River at Clifton Court Ferry for the Proposed Action Compared with Existing Condition (2001 LOD), 1976–1991



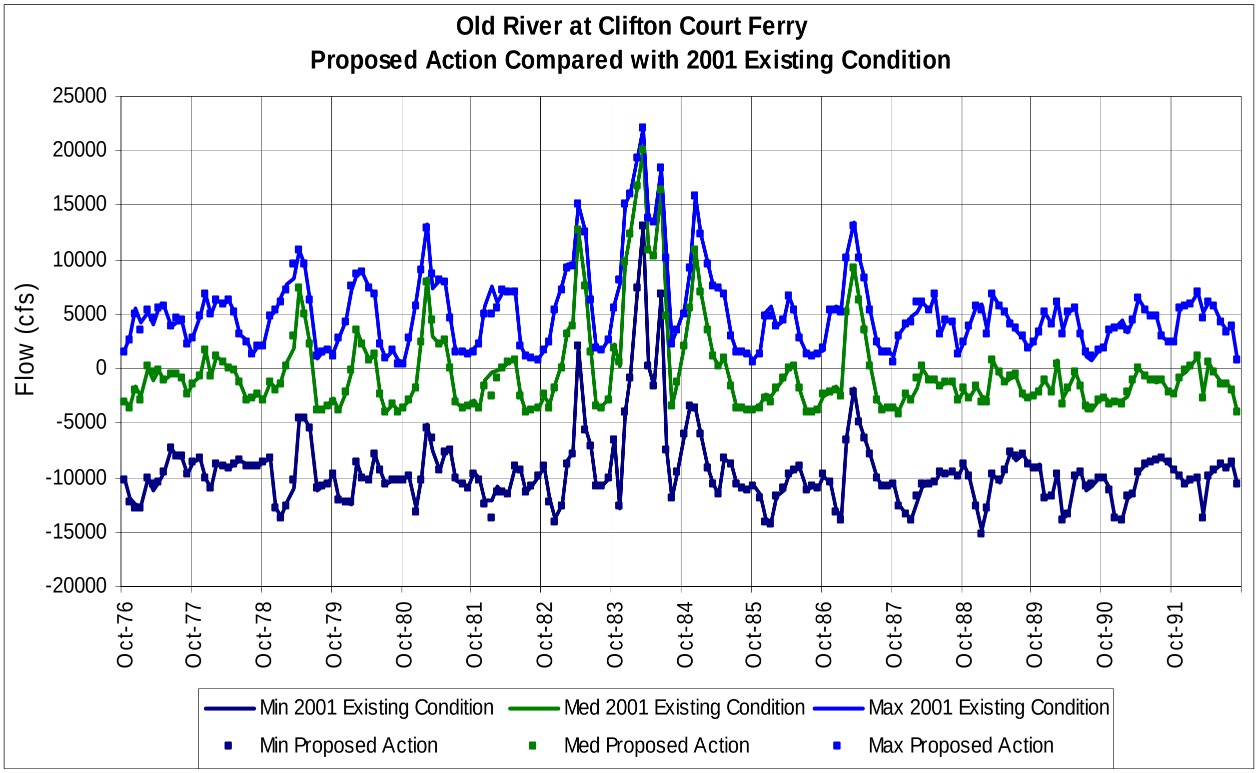
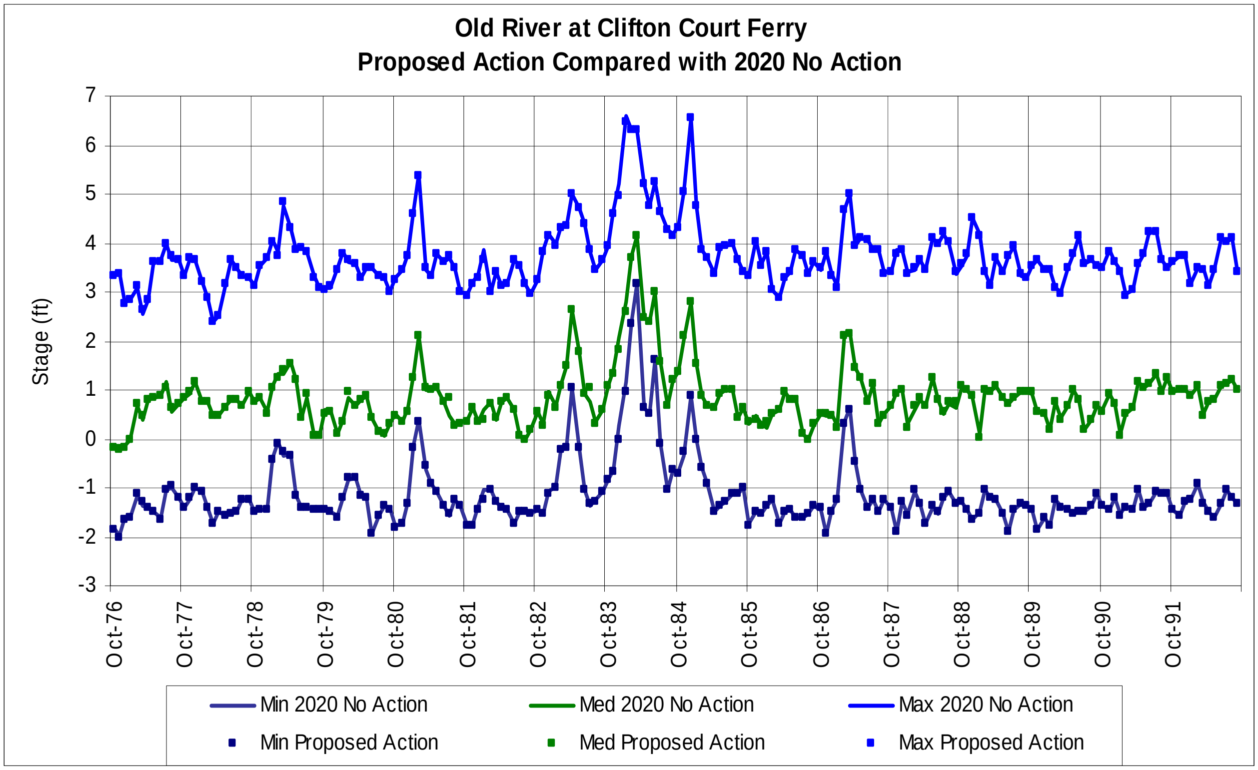


Figure 3.3-4. DSM2–Simulated Tidal Stage and Tidal Flow in Old River at Clifton Court Ferry for the Proposed Action Compared with No Action (2020 LOD), 1976–1991



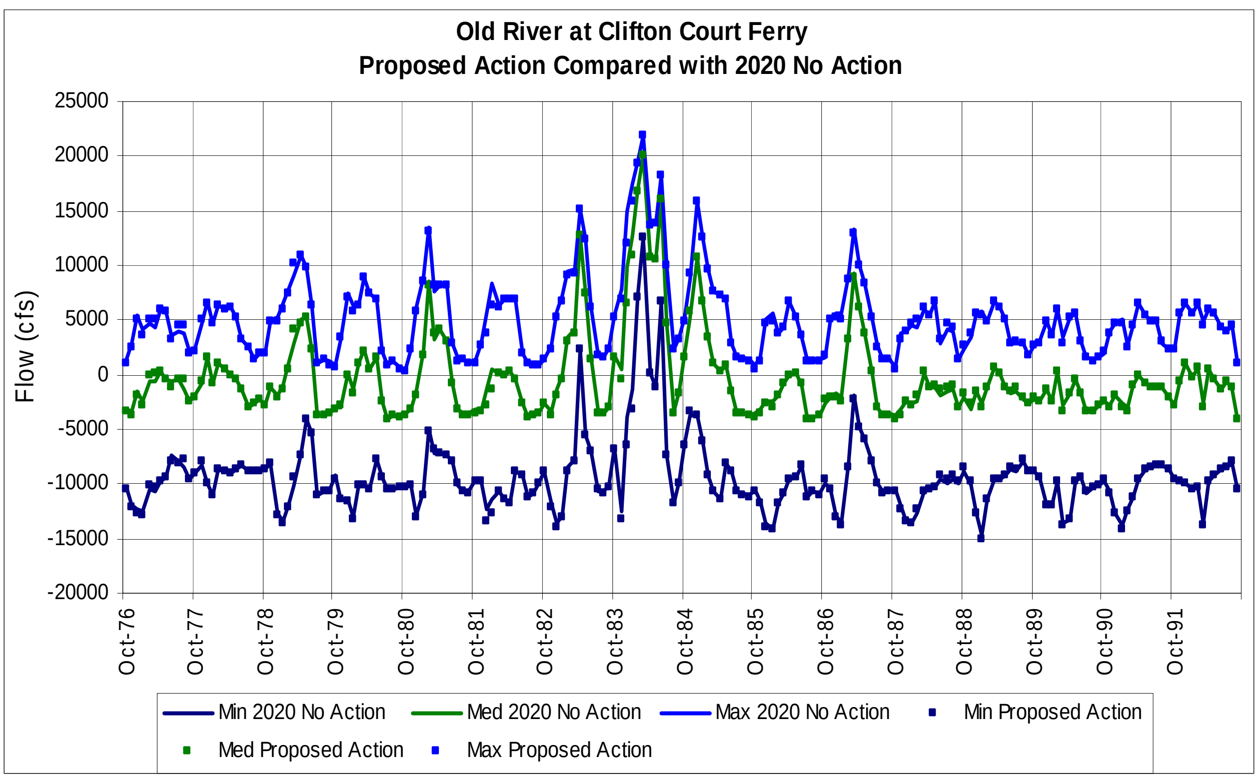
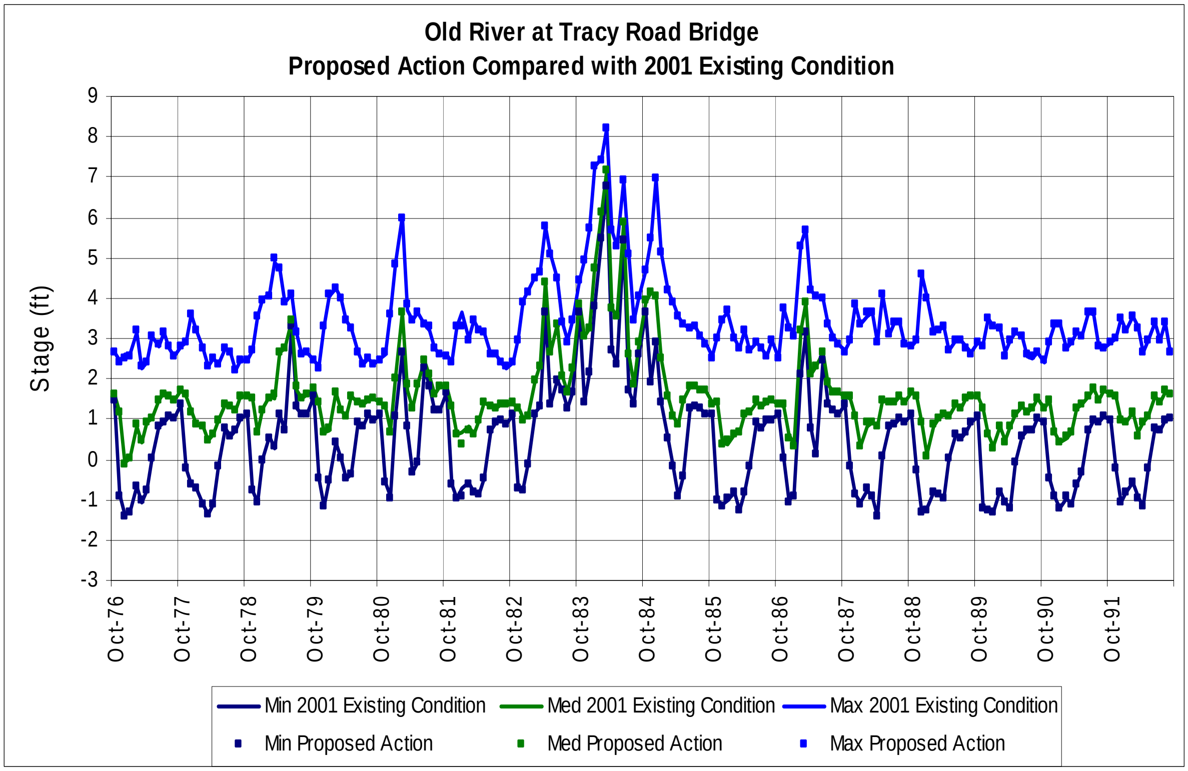


Figure 3.3-5. DSM2–Simulated Tidal Stage and Tidal Flow in Old River at Tracy Road Bridge for the Proposed Action Compared with Existing Condition (2001 LOD), 1976–1991



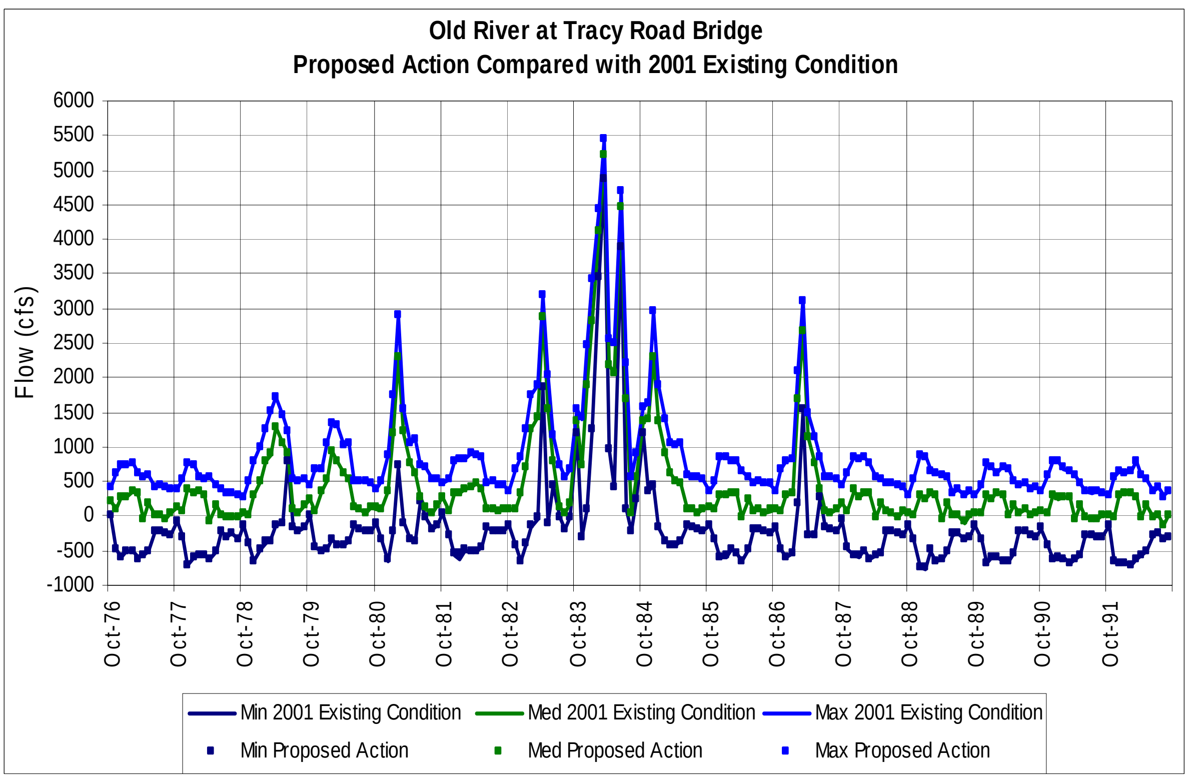
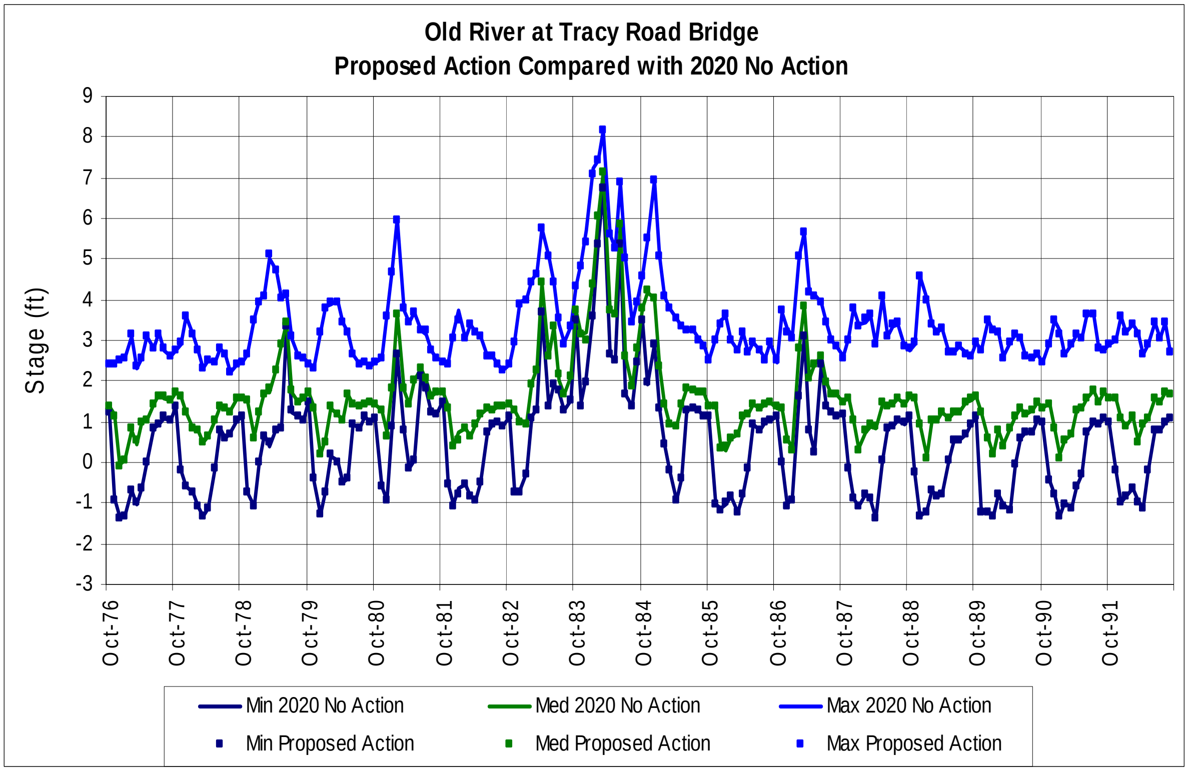


Figure 3.3-6. DSM2–Simulated Tidal Stage and Tidal Flow in Old River at Tracy Road Bridge for the Proposed Action Compared with No Action (2020 LOD), 1976–1991



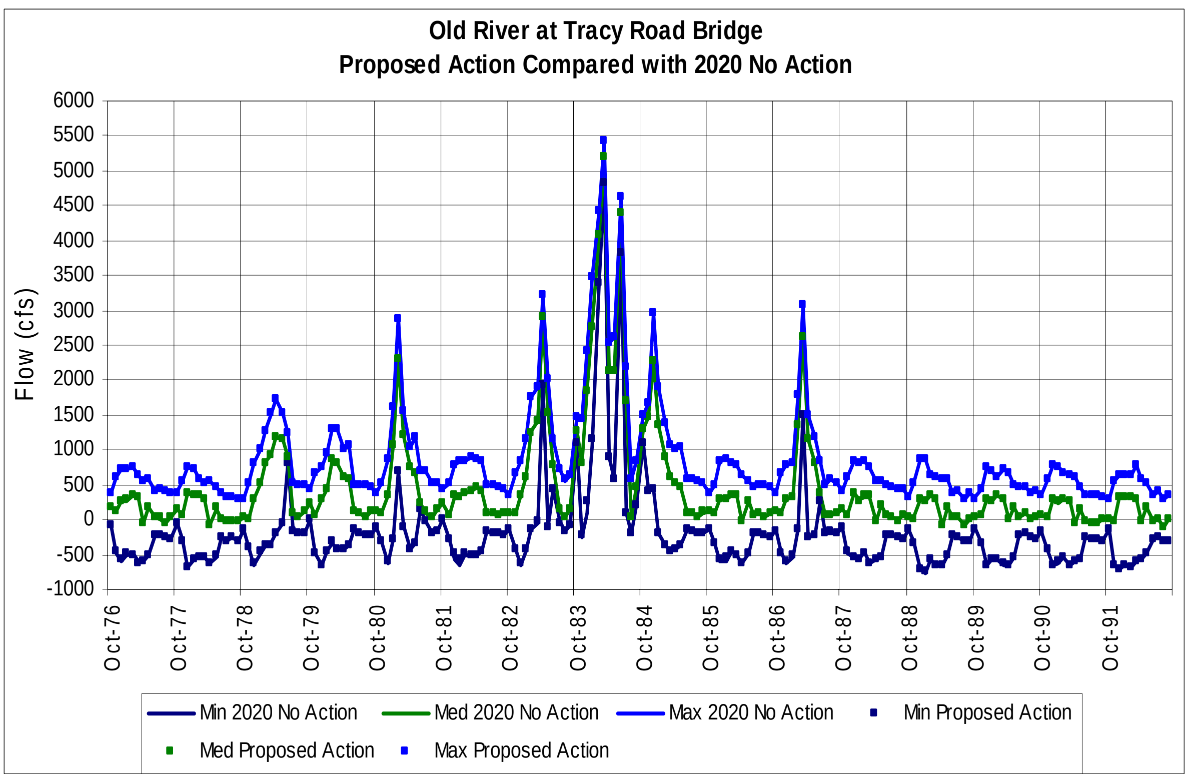
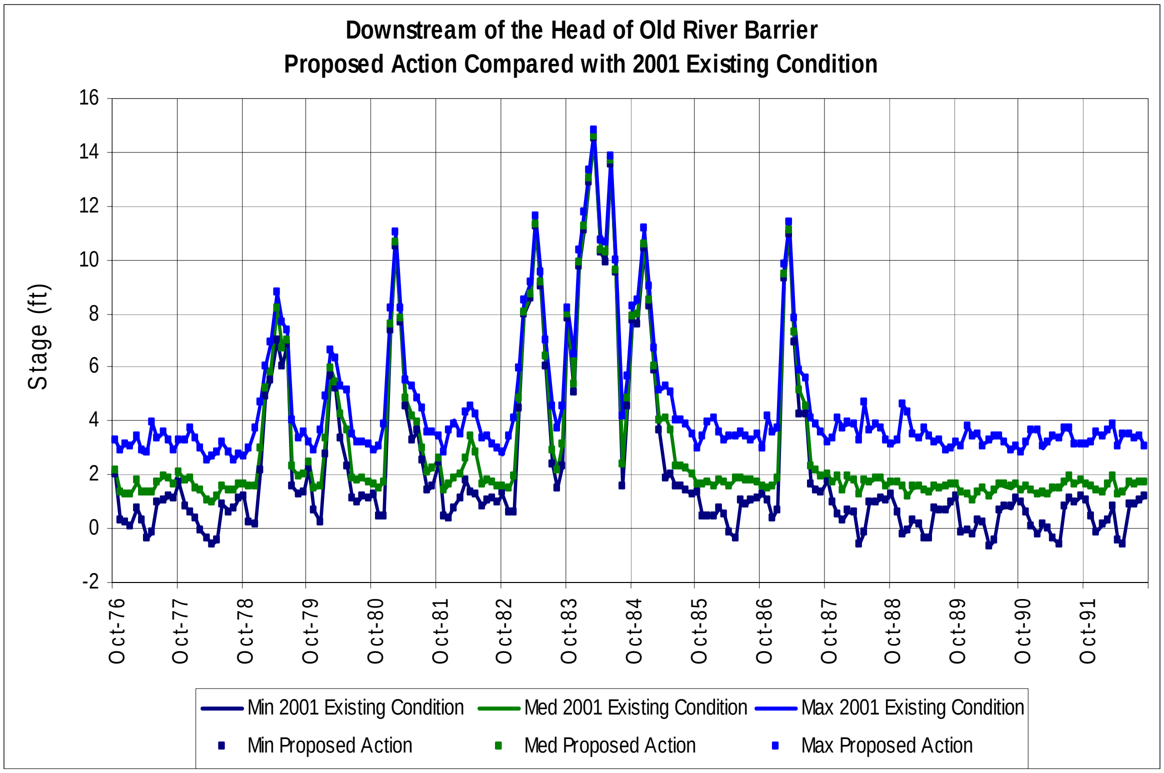


Figure 3.3-7. DSM2–Simulated Tidal Stage and Tidal Flow in Old River at the Head of Old River for the Proposed Action Compared with Existing Condition (2001 LOD), 1976–1991



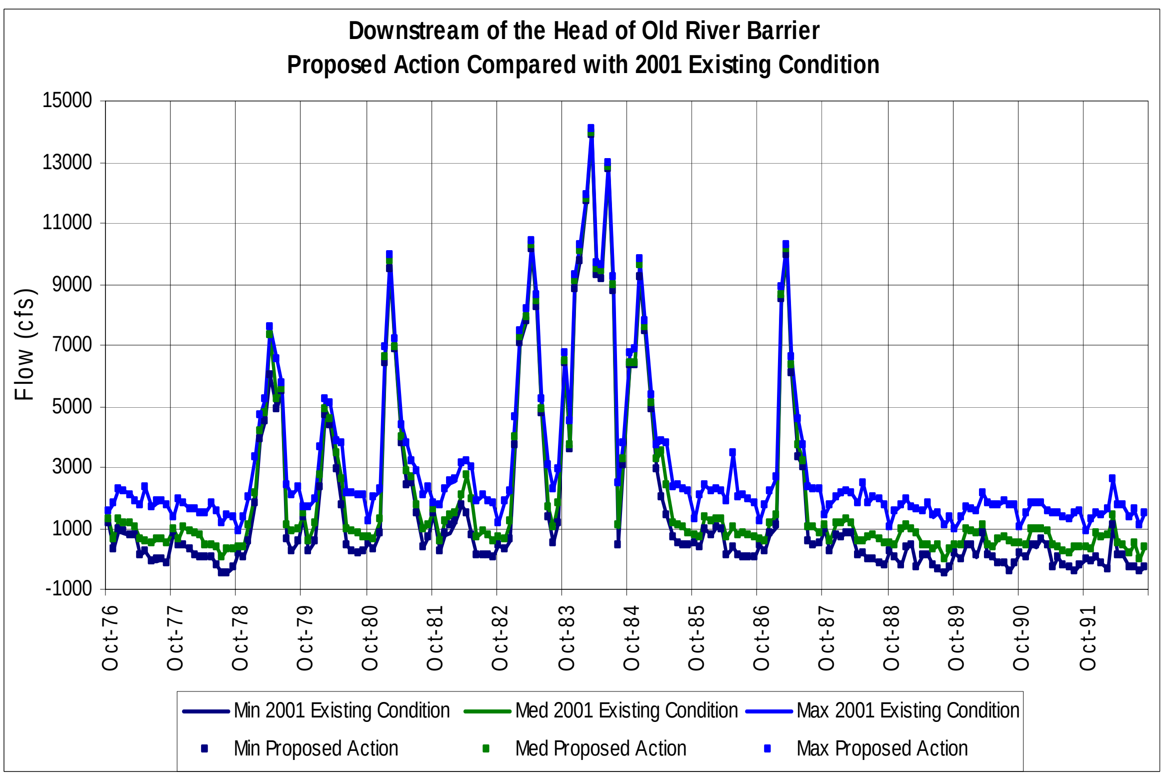
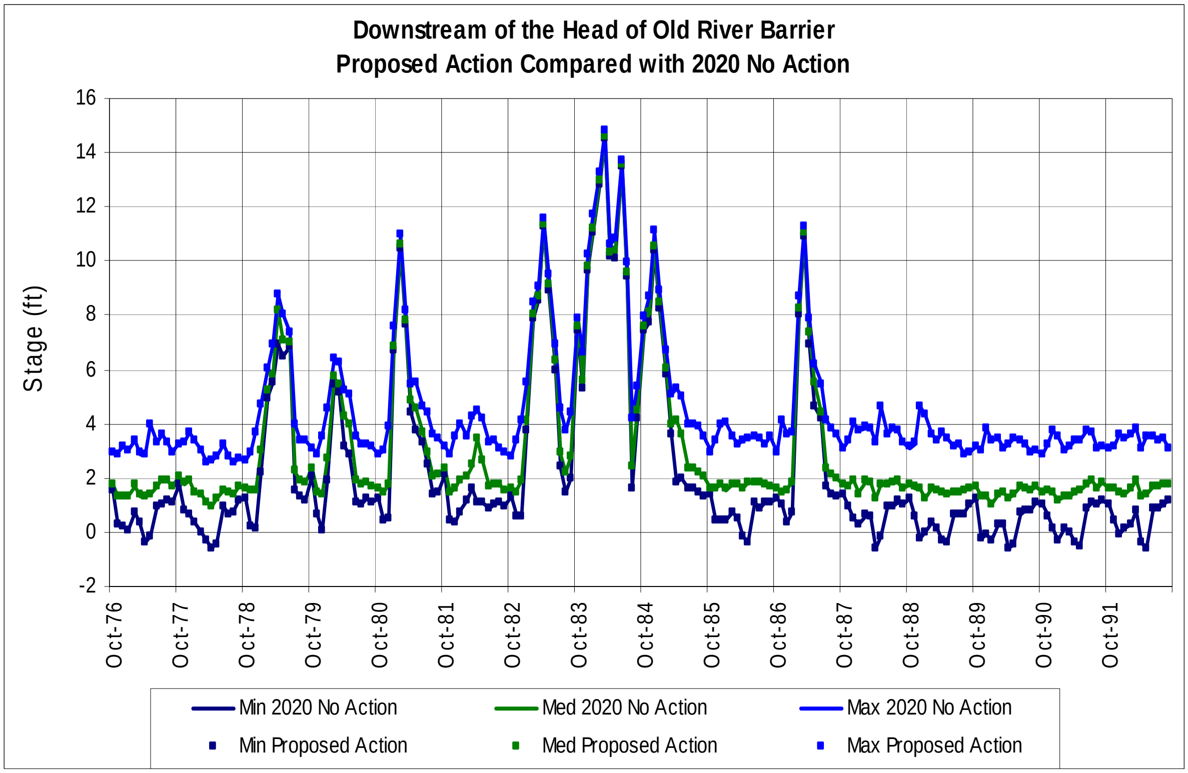


Figure 3.3-8. DSM2–Simulated Tidal Stage and Tidal Flow in Old River at the Head of Old River for the Proposed Action Compared with No Action (2020 LOD), 1976–1991



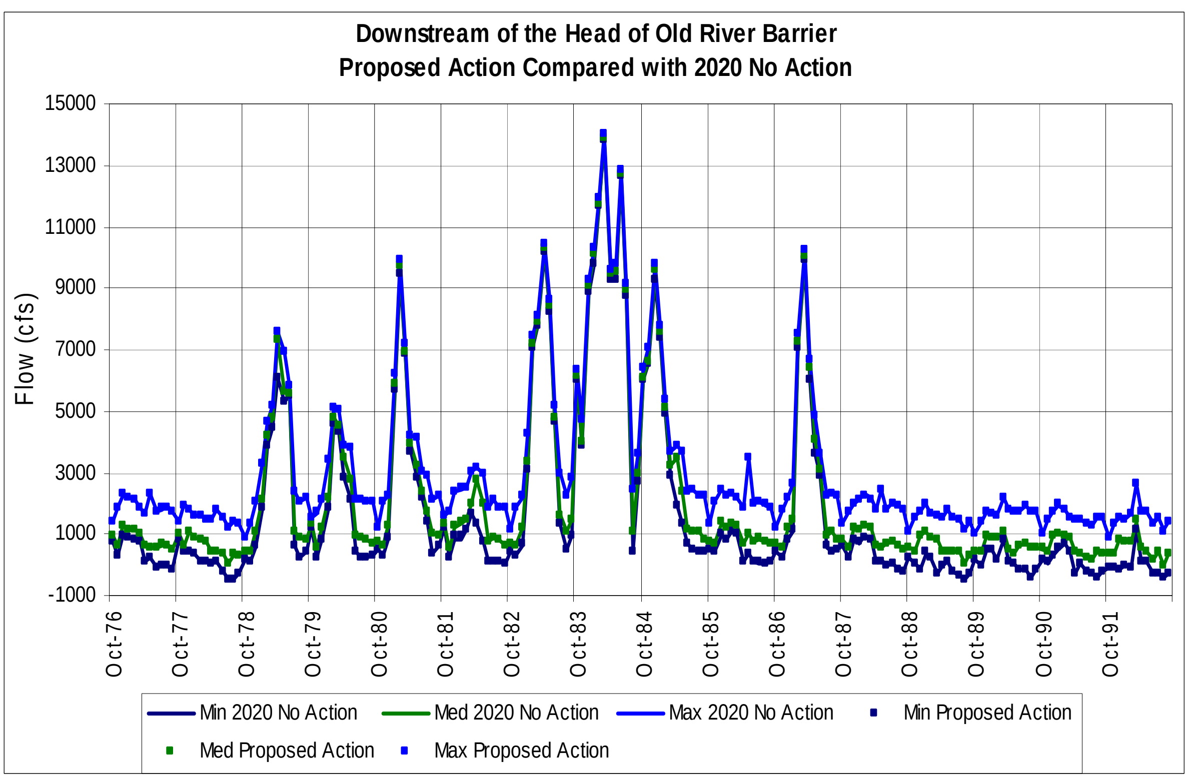
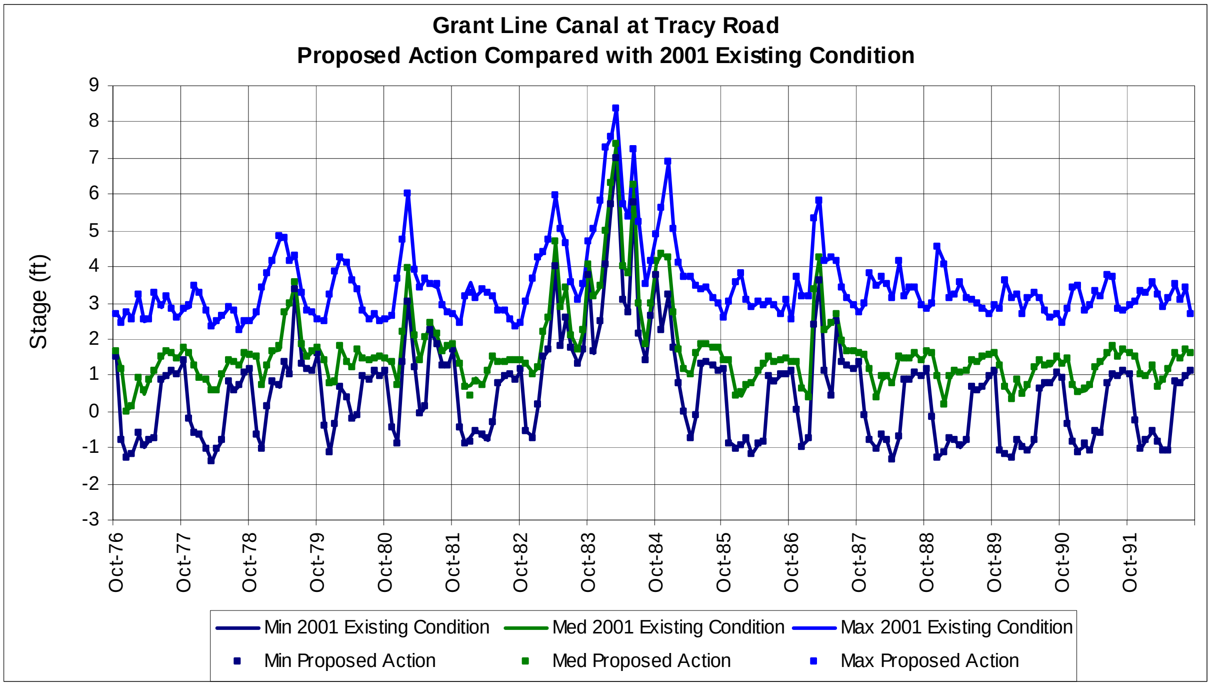


Figure 3.3-9. DSM2–Simulated Tidal Stage and Tidal Flow in Grant Line Canal at Tracy Road Bridge for the Proposed Action Compared with Existing Condition (2001 LOD), 1976–1991



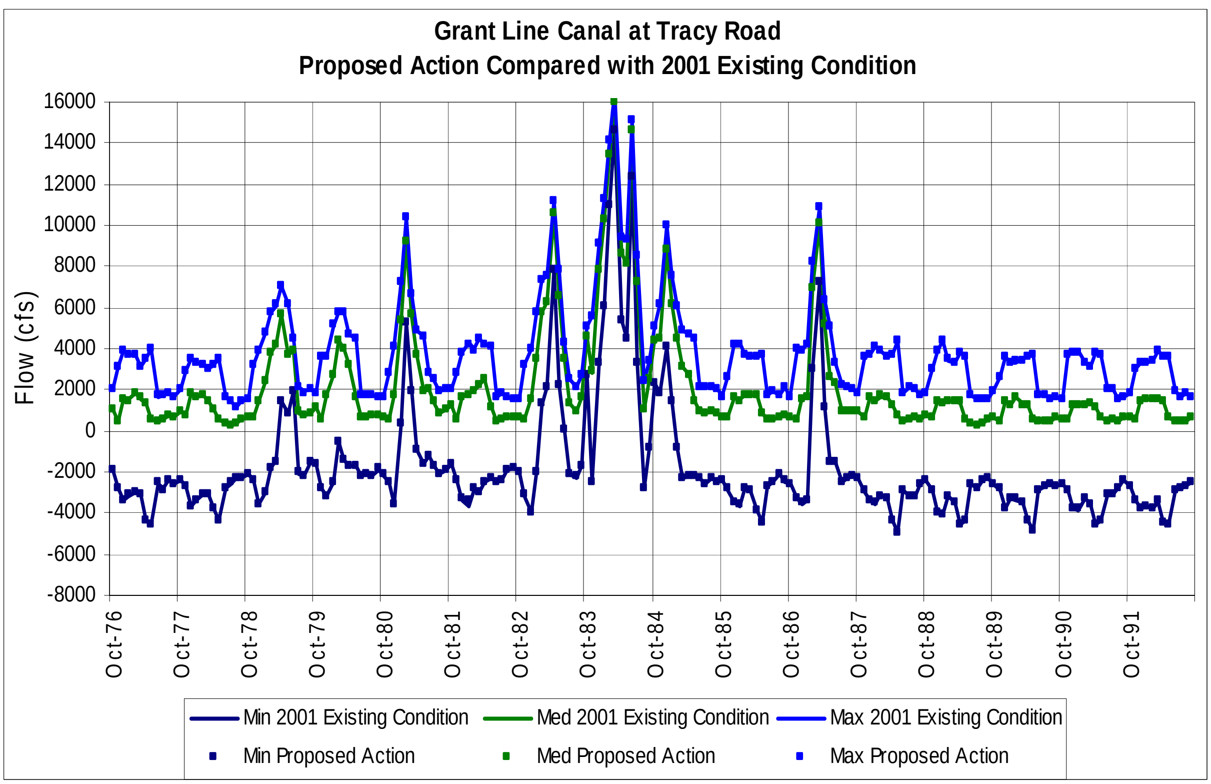
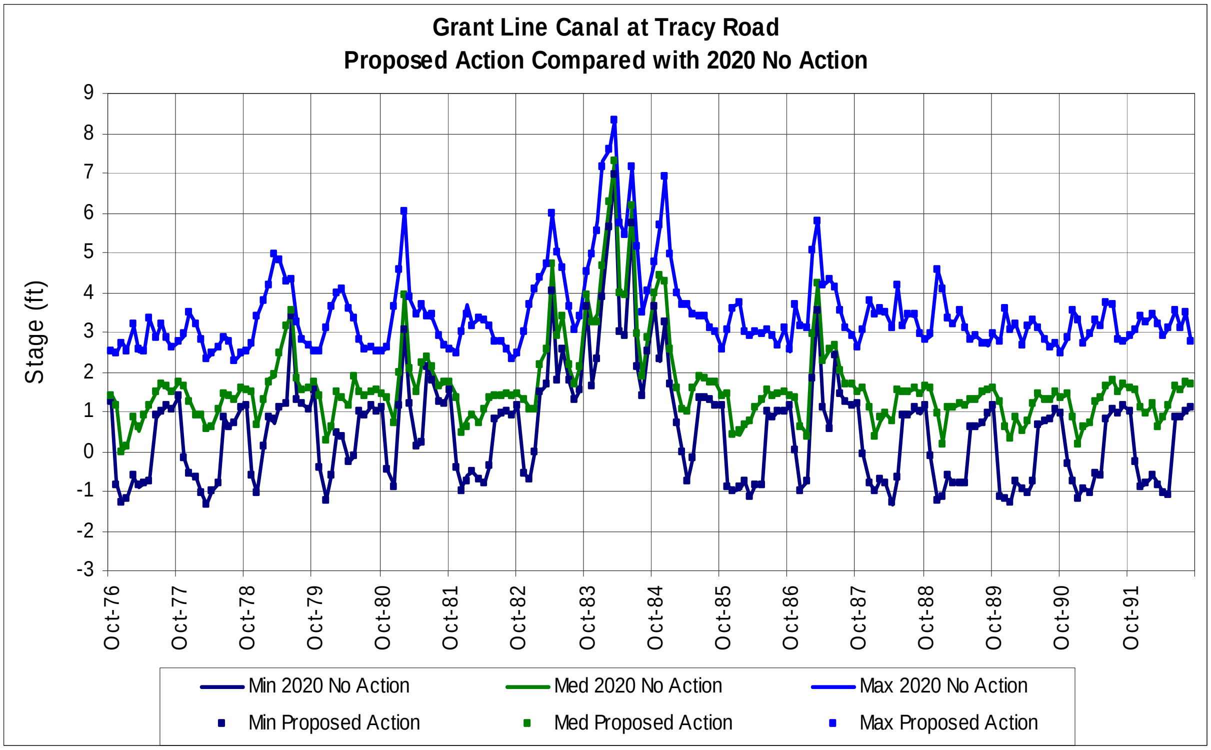


Figure 3.3-10. DSM2–Simulated Tidal Stage and Tidal Flow in Grant Line Canal at Tracy Road Bridge for the Proposed Action Compared with No Action (2020 LOD), 1976–1991



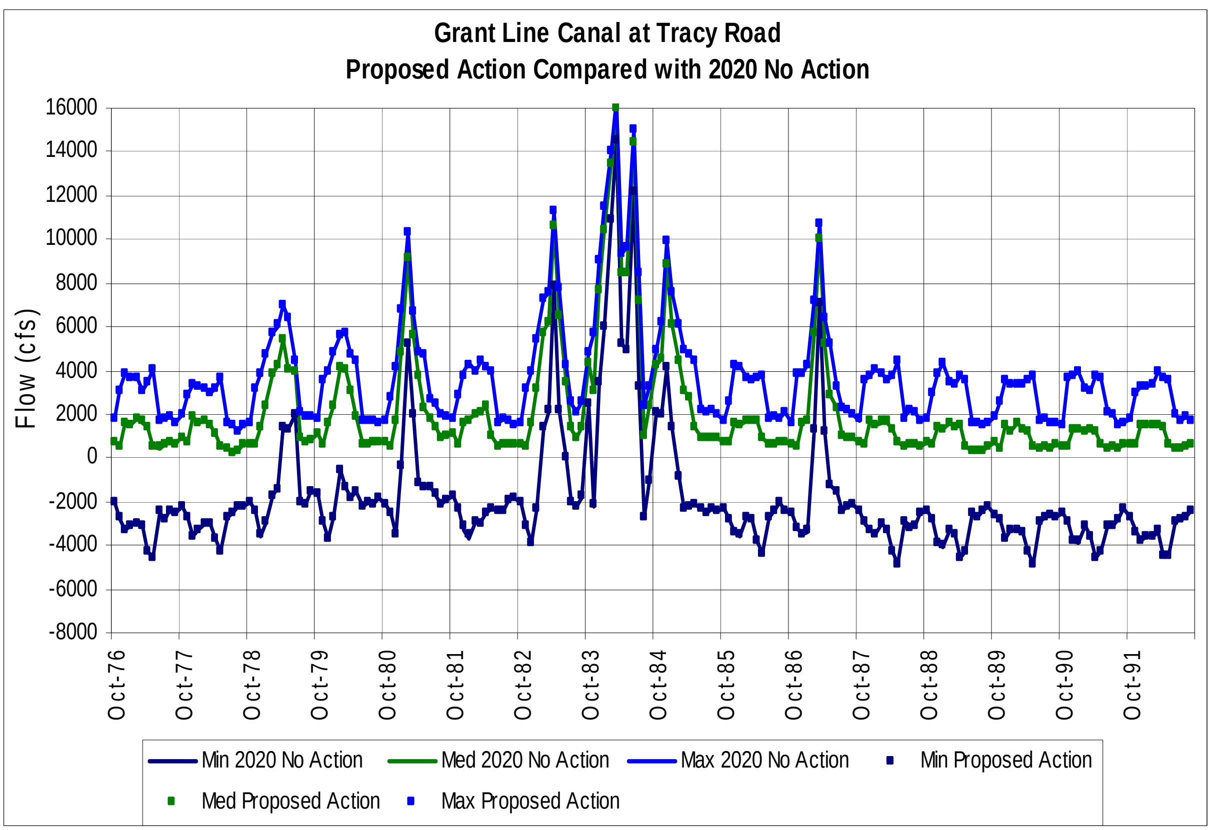
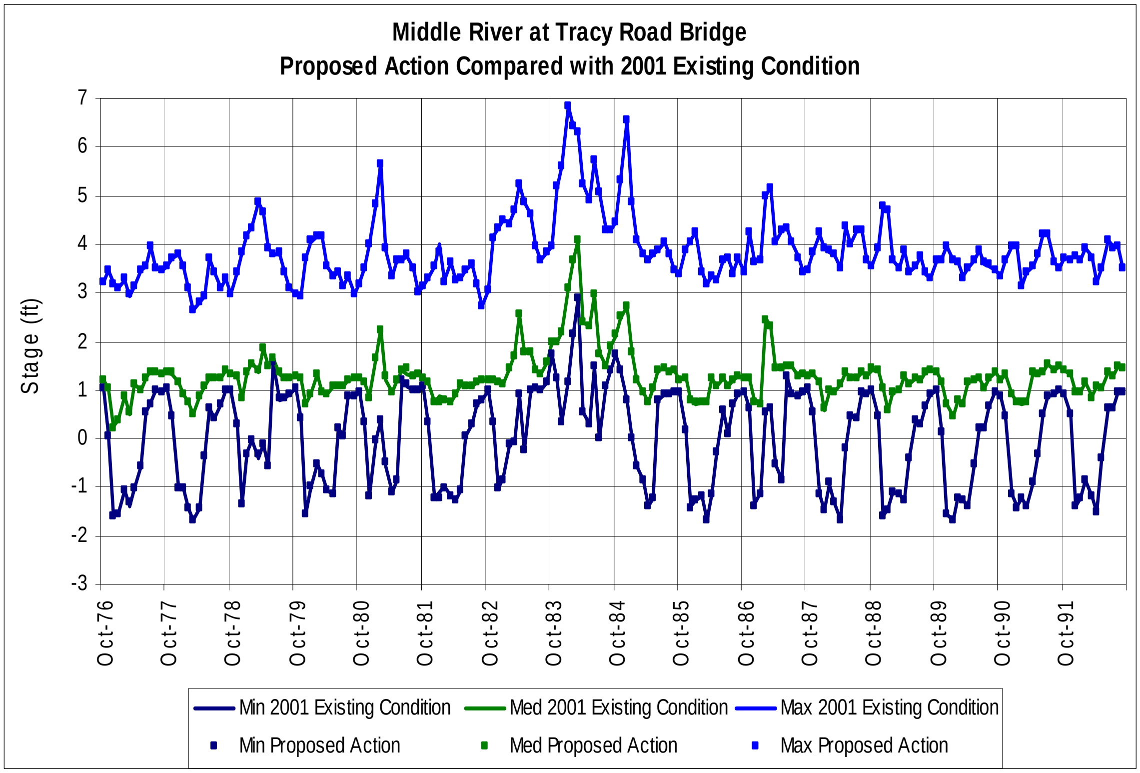


Figure 3.3-11. DSM2–Simulated Tidal Stage and Tidal Flow in Middle River at Tracy Road Bridge for the Proposed Action Compared with Existing Condition (2001 LOD), 1976–1991



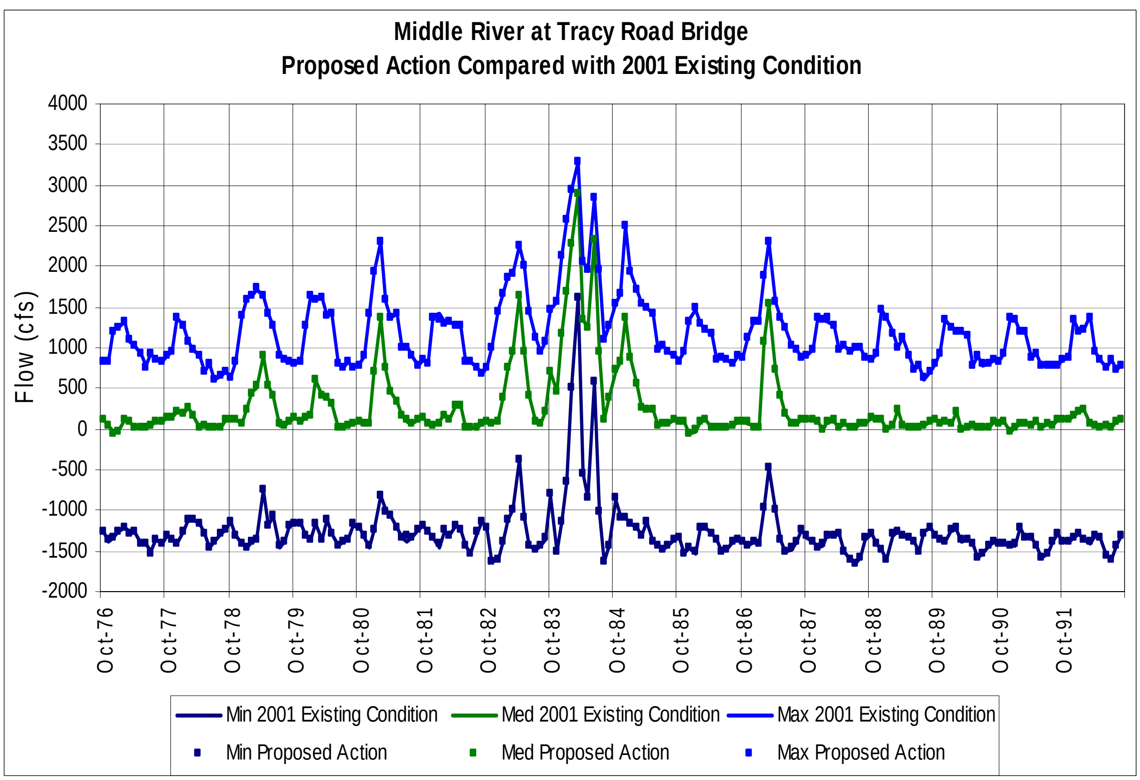


Figure 3.3-12. DSM2–Simulated Tidal Stage and Tidal Flow in Middle River at Tracy Road Bridge for the Proposed Action Compared with No Action (2020 LOD), 1976–1991